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Adaptive COPE
Annual Report

October 1, 1990 - September 30, 1991

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Adaptive COPE Program
Hatfield Marine Science Center
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THE COASTAL OREGON PRODUCTIVITY ENHANCEMENT (COPE) PROGRAM

Initiated in 1987, the Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between the College of Forestry at Oregon State University (OSU), the USDA Forest Service Pacific Northwest Research Station (PNW), the USDI Bureau of Land Management (BLM), other federal and state agencies, forest industry, county governments, and the Oregon Small Woodland Association. The intent of the program is to provide resource managers and the public with information on management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. To find effective ways to manage these diverse resources collectively, the COPE Program integrates research, education, and scientific disciplines.

The COPE Program has two related components; scientists in both Fundamental COPE and Adaptive COPE focus on problems related to riparian zone management and the regeneration of Oregon Coast Range forests. Fundamental COPE scientists, mainly from OSU and PNW in Corvallis, conduct basic research studies. Adaptive COPE is an interdisciplinary team of OSU College of Forestry scientists who are responsible for applying and adapting existing research to Oregon Coast Range conditions. Stationed in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for facilitating information transfer by providing continuing education opportunities. Adaptive COPE scientists work with county Extension forestry agents to extend the program throughout the 13-county area of the Oregon Coast Range. Basic research under Fundamental COPE is supported by the USDA Forest Service and USDI Bureau of Land Management. The Adaptive COPE program is funded by over 35 different organizations, including federal and state agencies, forest industries, and coastal counties.

COPE ORGANIZATION

Advisory Council

Representatives of COPE Cooperators

Provides advice and guidance on program direction (listing inside back cover).

Dean, College of Forestry

George Brown

Convenes Advisory Council. Makes major decisions on OSU support.

Director, PNW Station

Charles Philpot

Makes major decisions on PNW support.

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COPE Program Manager

Stephen Hobbs

Coordinates activities of all organizations involved and provides overall program leadership and administration.

Adaptive COPE

OSU College of Forestry scientists

Conducts adaptive research and facilitates transfer of information.

Fundamental COPE

OSU and PNW scientists

Conducts basic and applied research.

Adaptive COPE Staff

Gabriel Tucker, coordinator

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Engineering/Hydrology	Arne Skaugset

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COOPERATORS

Federal Agencies

Bureau of Indian Affairs
Bureau of Land Management
Pacific Northwest Research Station
Siskiyou National Forest
Siuslaw National Forest
U.S. Fish and Wildlife Service

State Agencies

Department of Fish and Wildlife
Department of Forestry
Oregon State University

Oregon Counties

Benton
Clatsop
Coos
Curry
Douglas
Josephine
Lane
Lincoln
Washington
Yamhill

Forest Industries

Boise Cascade Corporation
Champion International Corporation
Georgia-Pacific Corporation
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Hydraulic & Machine Services, Incorporated
James River Corporation
Longview Fibre Company
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Willamette Industries, Incorporated
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Other

Oregon Small Woodland Association

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HIGHLIGHTS FOR FISCAL YEAR 1991

During its fourth year of research and education activities, Adaptive COPE:

- Initiated the planning for Adaptive COPE's large-scale manipulative experiment known as the Interdisciplinary Research and Demonstration Area Project (IRDAP), which will investigate the consequences of alternative silvicultural practices in both upslope and riparian areas.
- Continued ten projects on slope stability, wildlife, riparian silviculture, stream-borne woody debris, and reforestation.
- Published technical articles on the biodiversity of managed forests, the impacts of stream-borne large woody debris, modeling wildlife habitat, and underplanting of conifers in riparian zones.
- Published four issues of the *COPE Report* quarterly newsletter highlighting COPE Fundamental and Adaptive research and technology-transfer activities; newsletters were distributed to over 2,000 subscribers.
- Sponsored a major workshop on "Managing Forest Biodiversity: A Coastal Northwest Perspective" (200 participants) and a field tour on "Landslides, Fisheries, and Forestry in Southwest Oregon" (61 participants).
- Gave numerous formal and informal presentations about the COPE program and related technical topics pertaining to forest resource management.
- Displayed three posters of COPE research at several forestry research and extension events.
- Continued to exchange information about the COPE program with cooperators and coastal citizens through field tours, office visits, and consultations.

INTRODUCTION

Historically forest managers have focused most of their attention on sawlogs and fiber production. This, after all, was where the vast majority of the economic return from forests was to be realized. When concern arose for the preservation of other resources, specific areas of land were designated—for example, as wildlife refuges or municipal watersheds. With increasing demand for the full range of forest resources, foresters are no longer able to set aside such large tracts of land; a multiple-use approach is thus more important than ever. In addition, the public's increased awareness of the importance of both tangible and intangible forest resources is affecting the management process on both public and private lands. These are challenging times, and it is in response to new information needs that the COPE Program was created.

The funding for COPE comes from a diverse array of cooperators, including private industry, federal, state, and county governments, and small non-industrial woodland owners. This diversity makes for a strong commitment to the development of objective multiple-use land management technologies effective throughout the Oregon Coast Range.

The COPE program is comprised of two major components. The Fundamental COPE Program conducts basic research from the OSU and USDA Forest Service research labs in Corvallis. The second group, known as the Adaptive Research Program, conducts more applied research and technology transfer from their base at OSU's Hatfield Marine Science Center in Newport, on the Oregon coast. The Adaptive team is comprised of fisheries, hydrology, wildlife, and silviculture scientists working together to produce interdisciplinary forest management technologies.

In this fourth year of the program, the research and continuing education programs have continued to cover a broad array of subjects, including slope stability, wildlife habitat, alternative silviculture, large stream-borne woody debris, and reforestation. In addition, the team has embarked upon a larger interdisciplinary project of research and demonstration that will involve all of the disciplines within the Adaptive team. This report summarizes these activities and accomplishments.

SLOPE STABILITY

MODELING ROOT REINFORCEMENT IN SHALLOW FOREST SOILS

(Arne Skaugset and James Schroeder—Adaptive COPE; Marvin Pyles—OSU Forest Engineering Department)

Landslides are common in the Oregon Coast Range because of the combination of steep slopes, shallow soils, and prolonged and intense winter rainfall. Historically, road-related landslides have been the dominant source of management-caused erosion. As road construction and maintenance practices have improved, however, road-related landslides have diminished in importance, and the emphasis has shifted to landslides elsewhere in harvest units. These landslides are called in-unit slides.

Theoretically, in-unit landslides result when the roots of harvested trees decay, resulting in reduced soil reinforcement and thus reduced soil strength. The primary goal of this research is to determine whether the increase in soil strength attributable to root reinforcement can be modeled and predicted. The objectives of the project are 1) to develop an analytical model of the root reinforcement mechanism and 2) to test the validity of the analytical model under controlled conditions.

During the first year of the project, we developed a conceptual model of how roots reinforce soil (*COPE Report* 2(2):4-7). In addition, we spent considerable time figuring out how best to verify the analytical model. The method that was chosen was a physical model of a landslide, in the form of a tilting table that could simulate landslide conditions. Finally, we prepared a laboratory at the Hatfield Marine Science Center and installed the tilting table.

During the second year of the project we developed support technologies for the tilting table. The most critical of these technologies was a data acquisition system that tracks the displacement of soil in the tilting table without affecting the reinforcement process. The system uses digital image analysis and a television camera connected to a "frame grabber board" in a personal computer to track the location of targets (ping-pong balls) placed on the soil surface. As the tilting table with the soil and targets is raised, the data acquisition system detects motion, and successive images of the targets are "grabbed" and saved to disk. After the simulated landslide, the "grabbed" images are retrieved, and target locations in each image are converted to x-y-z coordinates on the soil surface. Thus, the trajectory of each target can be tracked through successive images to yield a history of the deformation of the soil surface. This system has been tested by comparing results from our data acquisition system with more traditional measurements that use close range photogrammetry. Analysis of the test data showed no significant differences between the two techniques. A more complete description of the tilting table and the data acquisition system was presented in *COPE Report* 3(1):2-4.

Although we have made no major breakthroughs during the third year of the project, we have seen slow but steady progress. For the analytical model, we have derived the differential equations used to solve for the shape and stresses in the reinforcing elements as the soil undergoes deformation. Additionally, we have resolved the form of the algorithm of the finite-difference approximations for solving the differential equations; it awaits only coding at this time. We have also continued to prepare the tilting table for use. A basalt sand has been procured and the properties of the sand are being determined. A procedure for laying the sand in the tilting table at a repeatable density has also been worked out.

This research should increase our understanding of how roots reinforce shallow forest soils, and should therefore be valuable for managing landslide-prone terrain. It could be used for examining whether the stability of high-risk sites might be influenced by vegetation type and density, and for assessing the effect of alternative silvicultural practices on soil strength. The model would allow these effects to be evaluated at the planning stage. Present slope stability models that require information on root reinforcement could also be improved by incorporating additional information from this model.

STABILITY ASSESSMENT OF END-HAUL DISPOSAL AREAS

(Arne Skaugset and James Schroeder—Adaptive COPE; Marvin Pyles—OSU Forest Engineering Department; Dave Michael, Keith Mills, and John Seward—Oregon Department of Forestry)

End-hauling is the practice of loading and hauling road construction spoil from steep terrain to more stable locations; traditionally, sidecasting has been used for such material. Locating relatively flat, stable, disposal sites is a significant problem in the steep, highly dissected terrain of the Coast Range. Recent experience has shown that stability problems can occur even when the spoil material is placed on relatively flat, apparently stable terrain. Although the failure rate for end-haul disposal areas is small, the consequences of the failure can be significant. This problem has never been investigated rigorously, and therefore there are no formal criteria for selecting end-haul disposal sites. The objective of this project is to investigate current methods of stability assessment for end-haul disposal areas, and to develop information that will help field engineers assess the stability of potential end-haul disposal sites.

This research aims to develop an inventory of large end-haul disposal sites (volume >10,000 cubic yards) throughout the Coast Range. After site surveys, a conceptual model of the geology and geomorphology of the sites will be developed. Failed end-haul disposal areas will be back-analyzed to determine limiting strength values of the soil and rock. These values will be used to analyze potential disposal areas in similar terrain. Slope stability analysis will include several different models and analysis techniques. The results should help forest engineers choose the most appropriate slope stability model, analysis technique, and material parameters to assess the stability of potential end-haul disposal areas.

Work on this project is currently on hold. In the absence of a Fish Habitat Scientist, resources have been shifted to the fisheries projects to ensure their timely completion. Work on end-haul disposal areas will continue when Adaptive COPE's scientific staff is at full strength, or when other projects are completed and COPE's current scientists have more time.

WILDLIFE

WILDLIFE ABUNDANCE AND DIVERSITY IN MANAGED UPLAND FOREST LANDSCAPES

(Andrew Hansen, Pei-Fen Lee, and Eric Horvath—Adaptive COPE)

With the emergence of biological diversity as a mainstream issue on public lands in the Pacific Northwest, there is an increased interest in finding ways to optimize both wood production and conservation of wildlife diversity. By enriching habitat complexity in managed plantations, managers hope to retain native wildlife diversity; silvicultural approaches that maintain live canopy trees, snags, shrubs, fallen trees, and other habitat features are being widely advocated. Relatively few studies in the Oregon Coast Range, however, have compared habitat patterns and wildlife diversity between natural forests and managed plantations. Thus, little is known about the species that might be sensitive to timber management or about the habitat features required by these species.

At the landscape level, silvicultural practices can influence habitat patterns, including the size and edge characteristics of forest stands. Widespread concern over the fragmentation of natural forests and the loss of species that require large forest stands has resulted in cutting patterns designed to maintain large stands. In the Northwest, however, little information is available on animal species that might specialize on forest interior habitats and might therefore be sensitive to forest fragmentation.

This project examines forest structure, vertebrate communities, and edge effects in managed and natural forests in the Oregon Coast Range. The objectives are: 1) to describe within-stand forest structure in open-canopy plantations (clearcuts) (2-8 years), closed-canopy plantations (25-30 years), and natural mature forest (90-140 years); 2) to quantify associations between vegetation and wildlife within these forest types at the microhabitat and stand levels; and 3) to determine the distributions of vertebrate abundance relative to the borders between natural mature forests and either open- or closed-canopy plantation. Three study sites were established for each of these two edge types. At each site, three parallel transects were placed perpendicular to the edges, each extending 260 meters into the plantation and 400 meters into the mature forest. Vegetation structure and composition were recorded, and animal abundance was sampled by sight and sound (birds) and trapping (small mammals and amphibians) at 20-meter intervals along the transects.

Preliminary results from the first year of the 3-year study were reported in *COPE Report* 3(2):3-4. In summary, species richness of birds, small mammals, and amphibians was highest in open-canopy (clearcut) plantations, intermediate in natural mature forests, and lowest in closed-canopy plantations. Total abundances of birds and amphibians, respectively, were 50 and 130 percent higher in natural forest than in closed-canopy plantations. Eleven percent of bird species were more abundant in natural mature forest interior than near the forest edge, and 22 percent had higher densities in open-canopy plantations than at plantation edges. No species was strongly associated with the edges. Total bird density was considerably higher in forest and clearcut interiors than at the stand edges.

The second and final year of field sampling is now complete. All data have been prepared for analysis, and final analyses are underway. Data on bird response to forest edges from the second year corroborated that from the first year. Data from the combined years showed that some species were associated either with clearcut or forest interiors (Figure 1). Total bird abundance was especially low at edges between mature forest and clearcuts (Figure 2).

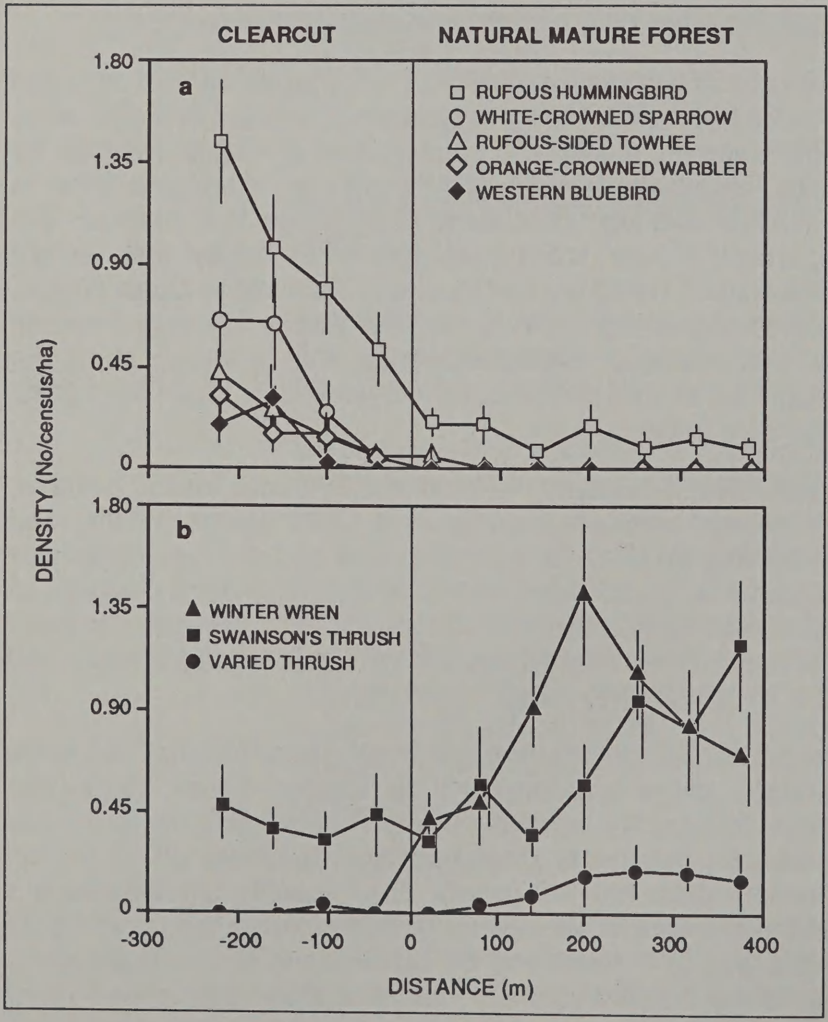

Figure 1. Bird species significantly associated with a) clearcut interior or b) forest interior habitats. Data points are averages (and standard errors) over two breeding seasons for 80-m sections along transects at three sites in the central Oregon Coast Range.

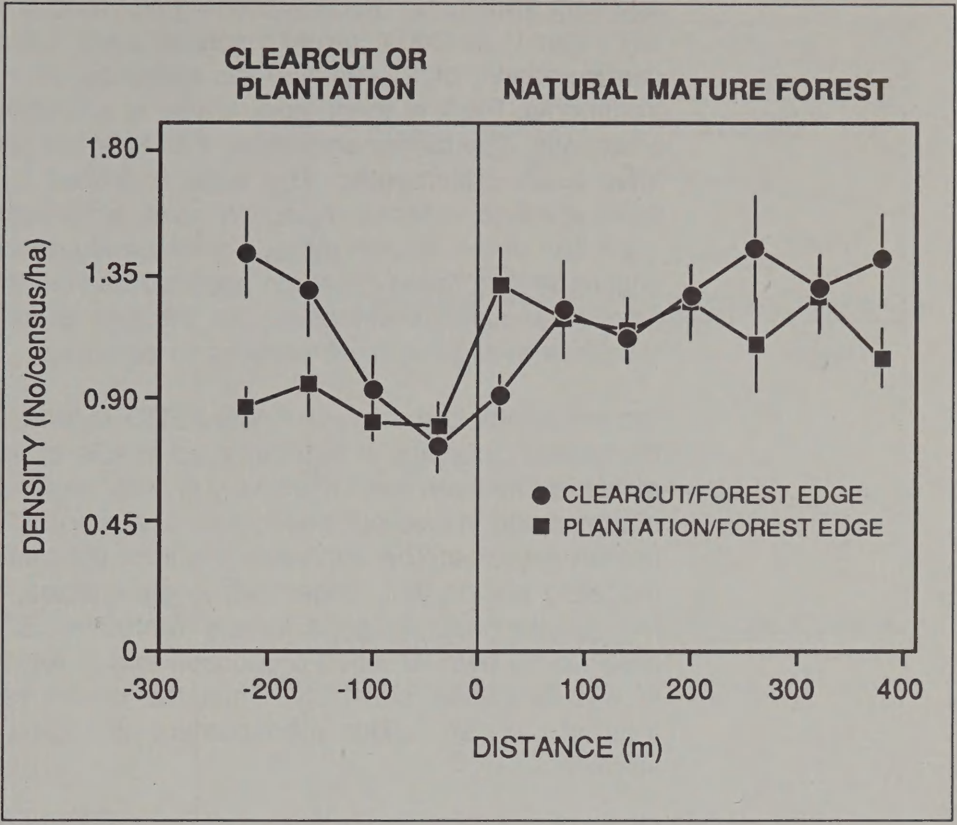

Figure 2. Total bird abundance (all species sampled) along two types of forest edge transect: clearcut/mature forest edge and closed-canopy plantation/mature forest edge. Data points are averages (and standard errors) for 80-m sections along transects at six sites in the central Oregon Coast Range.

When complete, the study should provide a fuller picture of the species that are sensitive to forest management practices and the habitat features these species require. This information will aid in the development of management strategies that optimize both wood production and species conservation.

This study was described in the *Northwest Environmental Journal* (6:418-419). The first-year results were briefly summarized in an article comparing natural and managed forests (*BioScience* 41(6):382-392). The data were also used to calibrate a landscape simulation model reported in a book on ecotones. The results have been widely reported at numerous continuing-education events.

ADAPTATION OF A FOREST SUCCESSION AND WILDLIFE HABITAT MODEL TO MANAGED COAST RANGE FORESTS

(Andrew Hansen and Steve Garman—Adaptive COPE; William McComb—OSU Forest Science Department; Dean Urban—Colorado State University; Barry Noon—USDA Pacific Southwest Research Station)

Forest scientists and managers are increasingly interested in identifying the responses of forest resources to differing stand- and landscape-level management strategies. Studies focusing on wood production and wildlife usually either 1) describe current resource levels in existing stand or landscape configurations, or 2) examine the response of resources to experimental treatments. Each of these approaches is valuable, but each has important limitations. The former omits new management strategies that may not yet have been implemented. The latter is limited by the relatively long time scale involved in forest dynamics; even a 10-year experiment covers only a fraction of the rotation cycle. Consequently, there is expanding interest in supplementing these research approaches with the use of computer models. Forest succession models can simulate an array of forest management practices over periods of decades to centuries.

We are adapting the forest model ZELIG to simulate tree, shrub, and wildlife habitat dynamics in the managed forests of western Oregon. This type of model has been used effectively in other regions to project the responses of mixed-age, mixed-species forests to a range of natural disturbances and human activities. The approach is one of the best available techniques for modeling stands that range from single-species, even-aged plantations to long-rotation, uneven-aged forests. Moreover, ZELIG outputs data on the model plots both as wood production and in terms that allow classification of wildlife habitat suitability. Thus the model can identify the long-term trade-offs under various management strategies for these two forest resources.

During this second year of the study we have reformulated portions of the model to better simulate Pacific Northwest forests; added subroutines for snags, fallen trees, wildlife habitat classification, and silvicultural prescriptions; acquired a large number of forest and wildlife habitat data sets from around the region for calibrating and testing the model; updated tree species input parameters; and conducted various application runs. During the upcoming year, model validation and applications for alternative silviculture will be completed.

To demonstrate the approach, we performed some initial applications using ZELIG. Appropriate vegetation and bird data were available for a natural forest stand in the H.J. Andrews Experimental Forest in the west-central Oregon Cascades. We initialized the model to stand conditions typical of younger patches in the stand (ca. 100 years old). Three forest succession scenarios were then simulated. The first depicted natural succession patterns in the absence of major disturbances over an 800-year period. In the second scenario, western hemlock was removed to depict the case where a dominant tree species is lost through management practices. Large Douglas-fir trees (>50 cm dbh) were removed in the third scenario to simulate selective harvest.

The natural succession run produced patterns of forest dynamics similar to those documented in the area. Douglas-fir and western hemlock were the most prevalent species, with western hemlock becoming dominant after several hundred years (Figure 3a). Removing western hemlock from the model resulted in slightly higher abundances of Douglas-fir and subordinate shade-tolerant species (Figure 3b). Removal of large Douglas-firs dramatically increased the abundance of western hemlock (Figure 3c).

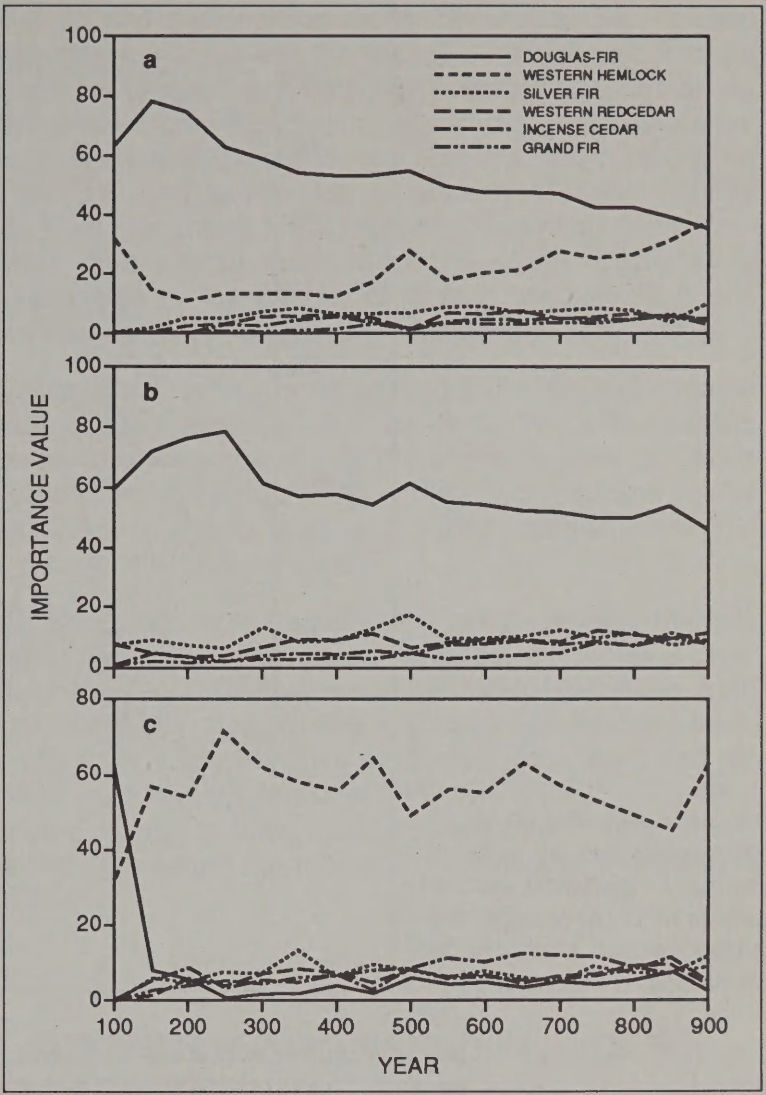

Figure 3. Simulated forest succession with ZELIG initialized for conditions at 1000 m elevation in the H.J. Andrews Experimental Forest in the Oregon Cascades under a) baseline conditions, b) western hemlock excluded from the analysis, and c) large Douglas-fir (>50 cm dbh) removed from the simulation.

Bird habitat suitability was dynamic over time. For example, the hermit warbler, an open-canopy specialist associated with intermediate-sized Douglas-fir, was most abundant in the baseline run prior to hemlock canopy closure and after gap dynamics opened the canopy later in succession (Figure 4a). Habitats for this species were also more abundant when hemlock or large Douglas-fir trees were removed. Habitat for the winter wren, a closed-forest specialist associated with intermediate and large hemlock, was greatest when large Douglas-fir were removed and least when hemlock was removed (Figure 4b).

This exercise provides a quick example of the ability of the model to project forest dynamics and animal habitat abundance under different management regimes.

Coast Range applications of the model will involve predicting the wood production and long-term habitat suitability of managed stands under a range of silvicultural treatments. The simulations will be run for 500-year periods in an experimental design that includes treatments related to rotation age (40-250 years), age structure (even-aged, uneven-aged stands), and habitat structure (snags, logs, shrubs, and live trees). Forest succes-

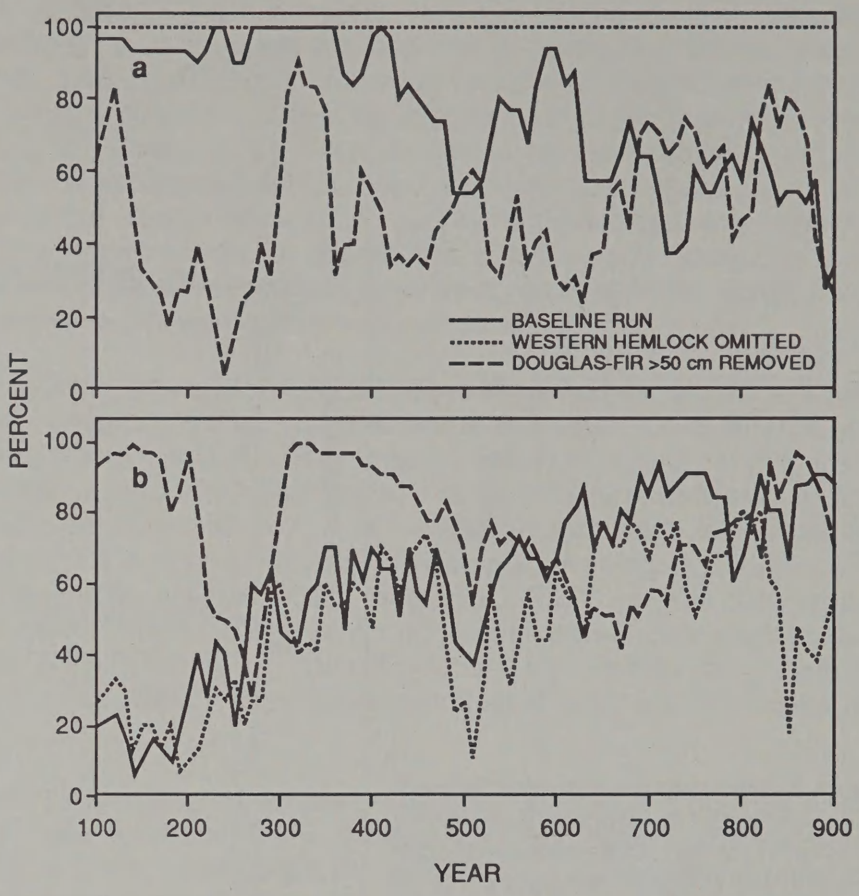

Figure 4. Percent of model plots classified as suitable habitat for a) hermit warbler and b) winter wren under the three forest simulations illustrated in Figure 3.

sion simulated according to a natural disturbance regime will serve as the control. The model will also be used to examine landscape-level management strategies involving harvest rates, harvest unit size, and edge characteristics. The results of this modeling effort will identify the wood production and wildlife habitat trade-offs involved in these alternative management strategies.

Two progress reports were prepared during this year, an article was published in the *COPE Report* (4(1):3-5), and the results were presented at various scientific and continuing-education events.

RIPARIAN SILVICULTURE

ESTABLISHMENT AND GROWTH OF CONIFERS UNDER EXISTING RIPARIAN VEGETATION

(Gabe Tucker, Steve McConnell, and Barbara Schrader—Adaptive COPE; Mike Newton—OSU Forest Science Department; Mike Cloughesy and Ralph Duddles—OSU Extension Service)

Until the practice of leaving buffer strips along streams began, riparian areas were generally clearcut along with the rest of a harvest unit. In most cases, such areas quickly became dominated by even-aged stands of red alder; such stands are commonly found along streamsides throughout the Oregon Coast Range. Many of these stands are now reaching maturity. As the overstory alder matures and deteriorates, an understory of salmonberry if present may take over the stand, precluding establishment of any tree species. The rehabilitation of riparian areas with herbicides is usually out of the question, both because of the danger of stream contamination and because some land managers no longer use herbicides in any setting.

Perhaps the most aggressive technique for altering these alder-dominated stands to favor overstory tree cover rather than salmonberry is underplanting with conifers. Once conifers are mature, they provide coarse woody debris to the stream, which enhances fish habitat; they may also provide a limited amount of commercial timber, as well as a more varied stand structure that is beneficial for a variety of wildlife species.

Starting in 1989, six alder-dominated riparian sites along the Oregon coast were underplanted with a variety of coniferous species, and several overstory and understory treatments were applied, including protection from browsing animals of half of the underplanted seedlings with flexible plastic mesh tubing. Bi-yearly measurements have continued since then, and the first-year results were recently published (*COPE Report* 4(2):2-4). Next year, in addition to data collection, each tubed tree will also receive protective netting as it grows higher than the tubing. This project is scheduled to continue through 1998.

RELEASE OF SUPPRESSED CONIFERS IN ALDER-DOMINATED RIPARIAN ZONES

(Gabe Tucker, Steve McConnell, and Barbara Schrader—Adaptive COPE; Bill Emmingham—OSU Forest Science Department)

When they are present, suppressed understory conifer saplings and seedlings may offer the most expedient method for reestablishing a conifer overstory in alder-dominated riparian areas. If this advance regeneration can be released through thinning, can avoid severe competition with salmonberry, and can reach a position of canopy dominance, then all of the objectives of underplanting may be achieved: these trees will provide the potential for limited commercial timber and they will increase fish and wildlife habitat. This alternative is much less expensive than underplanting, and it produces quicker results because the trees are already established.

Relatively little is known about release of advance conifer regeneration, as opposed to artificial conifer regeneration, and even less is known about conifer release in riparian as opposed to upslope locations. It seems likely, however, that shade tolerance may be more important than the ability to compete for water in shaded riparian environments. Ultimately, a set of overall thinning guidelines is needed; such guidelines would allow land managers to successfully release a conifer of a given size and species in a red alder stand of a given density and size and to do so without overly enhancing salmonberry or other competing vegetation.

To answer these questions, six alder-dominated riparian areas in the Oregon Coast Range were identified; each has a minimum of 60 suppressed conifers that are far enough apart to eliminate overlap of treatments. Each tree has been cleared of all surrounding alders, released by girdling alders, or left un-released as a control. Work began on the release of three sites in the winter of 1989-1990; this work was finished during 1990-1991. A detailed description of the study plan was published last year (*COPE Report* 2(4):2-4). This project is scheduled to continue until 1998, with preliminary results published in the interim.

LARGE STREAM-BORNE WOODY DEBRIS

INFLUENCE OF WOODY DEBRIS PIECE SIZE AND ORIENTATION ON FUNCTION IN SMALL STREAMS

(Arne Skaugset, Ron Rhew, and James Schroeder—Adaptive COPE; Bob Bilby—Weyerhaeuser; Jim Sedell—USDA Pacific Northwest Research Station)

Our understanding of the role played by large woody debris in creating and maintaining fish habitat has increased significantly in recent years. Debris influences sediment storage and pool types and sizes, thus affecting channel morphology. Management objectives now include long-term recruitment of large woody debris from riparian zones and the deliberate installation of instream structures to enhance fish habitat. However, relatively little research has quantified the effect of debris size and orientation on debris stability, channel morphology, and use of habitat by fish.

These questions are being examined through surveys of changes caused by debris placed in two small tributaries of Lobster Creek in the Alsea River basin during the summer of 1989. Logs bucked to 6-meter lengths were characterized by their diameter (20, 41, or 61 centimeters) and orientation (fully spanning the stream and perpendicular to flow, or angled downstream at 45°). Three logs of each diameter/orientation combination were placed in each stream, which gave a sample size of 36 logs. The debris locations and habitat were surveyed immediately following installation by means of a stadia traverse. A topographic map was made from the stadia traverse showing both banks, the thalweg, and points of interest, such as gravel bars and pools. Changes in debris location and channel morphology after the first year were measured by conducting a similar stadia traverse in 1990. Conventional survey techniques were used to measure fish populations and aquatic habitat.

First-year results suggest that the addition of woody debris may benefit debris-poor streams by diversifying channel morphology in homogeneous reaches (Figure 5). When debris was added, total residual pool area and volume increased for both streams. The habitat survey showed an increase in pool and glide habitat at the expense of riffles.

Second-year data collected in August 1991 include additional measurements. Stadia readings taken at the top of the bank provide more precise graphical representation of the channel. To simplify overlaying of the stadia and habitat survey data sets, stadia readings were also taken at habitat unit boundaries defined by fisheries biologists. Finally, fish population information is being combined with habitat information to assess potential changes in fish distribution within available habitat.

Results of the study will be helpful for predicting habitat improvement when woody debris is added to streams as part of stream enhancement projects, or for modeling habitat improvement due to natural recruitment of riparian trees to streams. The study will provide information for writing site-specific prescriptions for riparian areas that will maintain or improve aquatic habitat while allowing a compatible level of timber harvest along coastal streams.

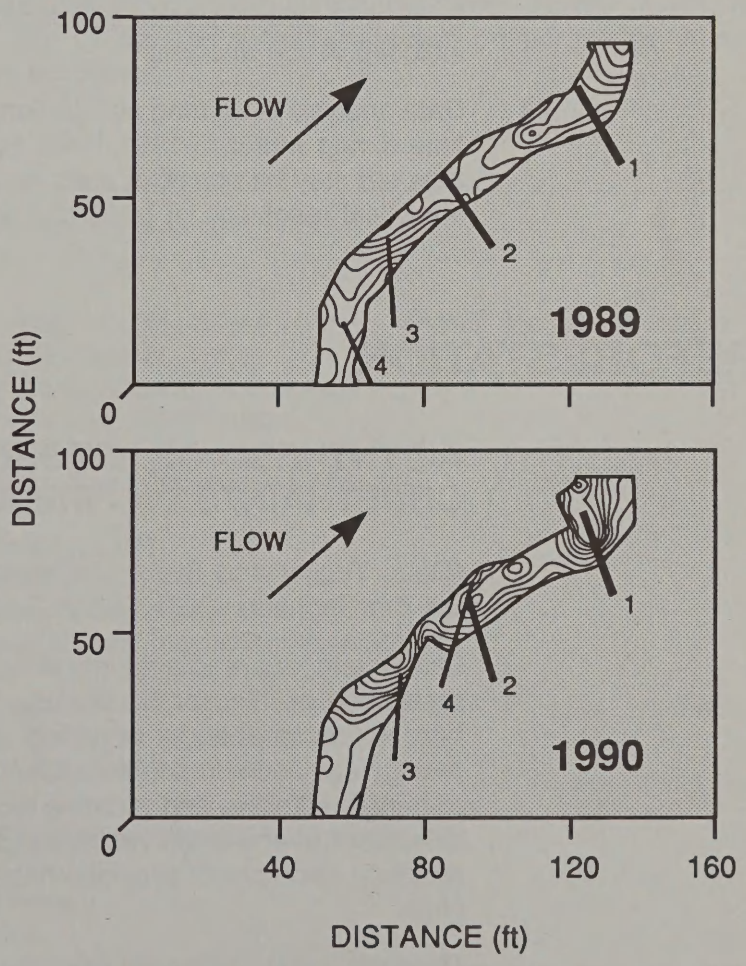

Figure 5. Topographic maps showing location of debris pieces and stream channel topography in 1989 and 1990 for an experimental reach of Preacher Creek. The contour interval is 0.4 feet.

LARGE WOODY DEBRIS AND FISH HABITAT IN COAST RANGE STREAMS

(Tom McMahon and Ron Rhew—Adaptive COPE; Robert Beschta—OSU Forest Engineering Department; Gordon Reeves and Jim Sedell—USDA Pacific Northwest Research Station)

Studies at numerous stream sites have established the importance of large woody debris (LWD) as an influence on fish habitat. As a result, most recent stream surveys carried out by resource managers and research agencies incorporate some measure of stream LWD loading. This project aims to promote a regional analysis of stream LWD characteristics by bringing together as much survey information as can be solicited from cooperating agencies. To date, we have compiled extensive survey information from approximately 70 streams (primarily provided by the Salem and Coos Bay districts of the BLM). In general, the majority of information comes from previously harvested basins, which means that other habitats are underrepresented. Additionally, there is little information on stream conditions north of the Nestucca Basin.

Preliminary analysis of available stream data indicates that LWD characteristics are poorly related to stream gradient, stream order, and stream linkage number. Thus conditions in the study basins may be better explained by stream cleaning, road building, splash damming, or other activities not included in the analysis.

Data analysis is nearing completion, with a draft publication expected some time during winter of 1991-1992. Further use and expansion of the current data set may be possible; such an analysis would increase descriptive and analytical resolution of LWD characteristics in coastal Oregon streams.

REFORESTATION

A SYNTHESIS OF REFORESTATION PRACTICES WITH CONSTRAINTS ON FIRE AND HERBICIDES

(Gabe Tucker and Steve McConnell—Adaptive COPE; Steve Hobbs and Bill Emmingham—OSU Forest Science Department)

Land managers reap a variety of benefits when reforestation efforts include prescribed burning or herbicides. Prescribed burning can help seedlings become established by providing temporary and effective control of competing vegetation. In addition, it limits pest habitat, allows for planter access to harvested sites, and reduces the potential for damaging wildfires. Herbicides control unwanted vegetation that competes with planted seedlings for moisture and light or provides habitat for animal pests that damage seedlings.

Recently, legal and social considerations have begun to constrain the use of these reforestation tools. The extent of constraint varies both by organization and by location. Constraints on prescribed burning have affected nearly all land management organizations. “Burn days” with acceptable meteorologic conditions are harder to come by because of the pressure to limit smoke encroachment into areas of human population or other restricted areas. Competition from other managers wishing to burn on these limited days means that few managers are able to burn as much as they like. Herbicide use within federal organizations was curtailed by court order in 1983; even if herbicides are again established as tools on federal lands, their use will probably be substantially restricted. Other organizations also occasionally limit herbicide use at their own discretion for various reasons.

As a result of limitations on prescribed burning and herbicides, many managers have experimented with alternative vegetation management treatments. Many innovations have been tried, modified, and improved. Information on these approaches has not been documented or shared among user groups, however, nor have the effectiveness and cost efficiency of the various techniques been compared. COPE scientists are currently preparing a synthesis of management alternatives used where prescribed burning or herbicides are constrained; the document will disseminate findings of managers and researchers throughout the Coast Range and allow for cursory comparison of the cost and efficiency of some of the techniques used.

With the additional new authors, the approach of this research has recently changed. The paper will now address techniques possible with partial restrictions on the use of fire and a total restriction on herbicides. A new outline for the paper follows:

Outline for the Reforestation Synthesis Paper

I. Introduction
II. Ecological Setting: Douglas-fir and western hemlock dominated forest of the Pacific Northwest
III. Manipulating the Operational Environment
IV. Reproductive Biology of Competitors
V. Current Practices
VI. Even-aged Silviculture (Regeneration Methods)
    A. Clearcut[1]
        1. No treatment (NT)
        2. Reduced fire (RF)
        3. Mechanical treatment (MT)
        4. Reduce fire and mechanical treatment (C)
    B. Seed Tree[1]
    C. Shelterwood[1]
VII. Uneven-aged Silviculture (Regeneration Methods)
    A. Group Selection[1] (NT, RF, MT, C)
    B. Single Tree Selection[1] (NT, RF, MT, C)
VIII. Research/Information Needs and Implications
IX. Summary
X. Acknowledgments
XI. Literature Cited

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[1] Cover the following periods for each regeneration method: preharvest, site preparation, post-planting.

EFFECTS OF FORAGE SEEDING ON ESTABLISHMENT AND GROWTH OF DOUGLAS-FIR SEEDLINGS

(Gabe Tucker and Barbara Schrader—Adaptive COPE; Tim Harrington—CRAFTS; Steve Hobbs—OSU Forest Science Department)

Forage-seeding has been operationally used for several years in the Oregon Coast Range as a method whereby exotic grasses and legumes are interplanted with coniferous seedlings in order to provide both wildlife nutrition and competition for unwanted perennial vegetation. The nutritional benefit for browsing wildlife, particularly elk, has been well documented, but little is known regarding the competitive effects of the forage on the commercial tree seedlings and on perennial vegetation such as salmonberry.

To investigate these effects, a cooperative project involving both CRAFTS (Coordinated Research on Alternative Forestry Treatments and Systems) and COPE has been started; most of the activity during this year involved experimental design and refining a project plan, in collaboration with interested cooperators.

IRDAP: INTERDISCIPLINARY RESEARCH AND DEMONSTRATION AREA PROJECT

Managers throughout the Pacific Northwest are currently developing and implementing alternative silvicultural systems aimed at optimizing forest growth and yield as well as maintaining biodiversity in upslope and riparian areas. On both private and public lands, varying densities of live trees, snags, fallen trees, and shrubs are being retained. In upslope areas, green tree retention may be dispersed or clumped within the cutting unit, which may improve ecosystem management; however, the ecological and operational consequences of such practices need to be further investigated, particularly with regard to the Oregon Coast Range forests.

Although this study does not officially begin until FY 1992, considerable time was spent in developing the proposal during FY 1991. The primary objective of this new study is to examine the operational-level responses of multiple forest resources to alternative management practices; the project focuses on structurally poor, harvest-age, second-growth stands in the Oregon Coast Range. In addition, the project aims to quantify the constraints and costs of implementing such treatments, and to provide a demonstration of selected silvicultural prescriptions.

The computer images in Figure 6 show a variety of possible upslope treatments, including:

a. **Objective** - Optimize both growth and yield of trees and diversity of plants and animals.

Target Stand - Multiple age classes; shrubs, snags, fallen trees; dispersed overstory.

Prescription - Retain 15 percent dispersed green tree basal area; no burning and limited site preparation; designated snags with recruitment; plant multiple species of large stock.

b. **Objective** - Optimize tree growth and yield and slope stability.

Target Stand - As in a), but with clumped retention.

Prescription - As in a), but clump retention along streams and/or in headwall areas.

c. **Objective** - Maximize tree growth and yield.

Target Stand - Stand of a single age class.

Prescription - Clearcut; broadcast burn; plant 2-0 Douglas-fir to close spacing; precommercial thin.

Additional treatments under consideration involve: 1) retaining 85 percent of the overstory to create an uneven-aged management scenario, and 2) an uncut control. Riparian prescriptions using various configurations of stream-borne woody debris will also be administered in conjunction with the prescriptions described above.

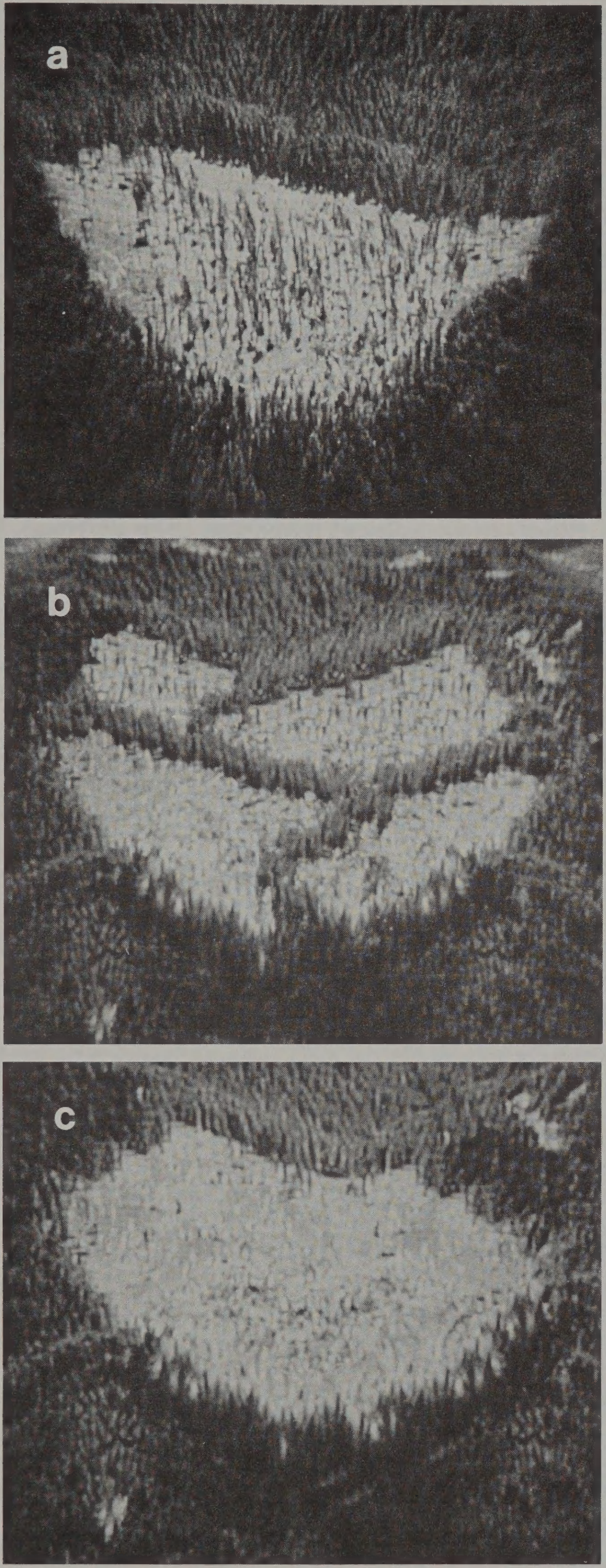

Figure 6. Computer-modified photographs showing three likely visual scenarios resulting from IRDAP up-slope silvicultural treatments: a) 15% overstory retention dispersed throughout harvest unit, b) 15% overstory retention aggregated along intermittent streams and headwalls, and c) traditional clearcut (Photo credit: Al Leveno and Jim Kiser).

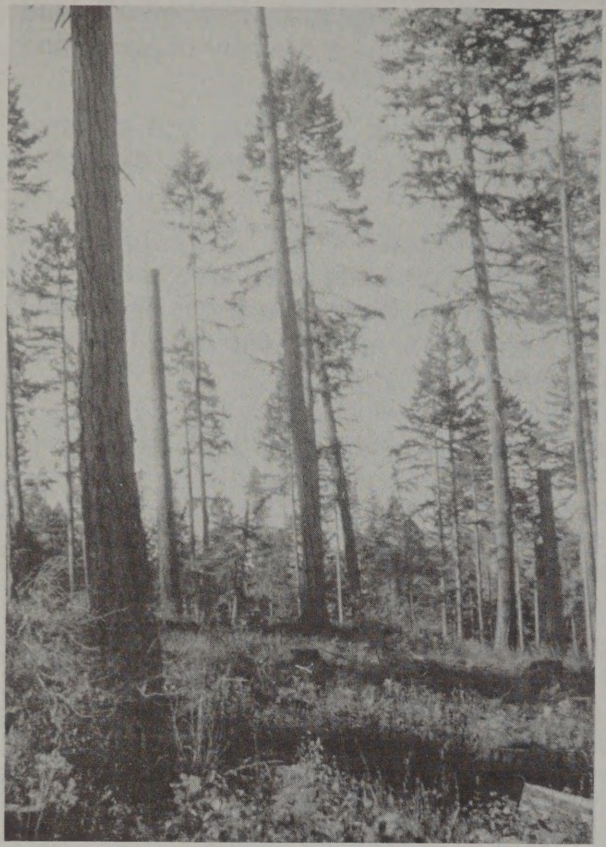

Figure 7. Alternative silviculture harvest unit in MacDonald Forest with dispersed green tree retention and topped trees for creation of artificial snags (Photo credit: Bill McComb).

Data collection for the study will concentrate on both the upslope areas (Figure 7) and the riparian areas with perennial streams (Figure 8). Parameters to be studied by the four disciplines within Adaptive COPE include:

- **Fisheries** - Primary production, invertebrate and vertebrate community structure and composition.
- **Hydrology** - Woody debris piece size and orientation, stream channel morphology, slope stability, soil compaction.
- **Wildlife** - Community structure and composition.
- **Silviculture** - Stand dynamics, tree morphology and water relations, understory light.

The silvicultural prescriptions should be installed by fall of 1993. Data collection will continue through 1997, and the project will finish in 1998.

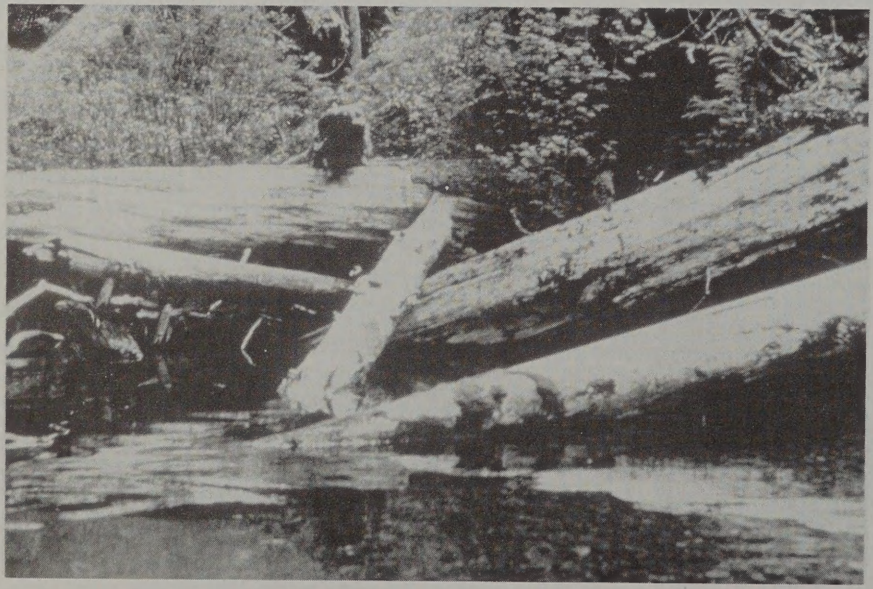

Figure 8. Large stream-borne woody debris provides diversity in stream morphology important for fish habitat (Photo credit: Tom McMahon).

EDUCATION

To ensure that research information developed by COPE is quickly available to a broad audience, Adaptive COPE scientists publish scientific papers, reports, and a quarterly newsletter, organize workshops, present formal presentations, lead field tours, and consult with cooperators. Forestry Extension agents assist in bringing COPE research findings and activities to the attention of the general public via their county Extension newsletters and workshops.

PUBLICATIONS AND REPORTS

Hansen, A.J., E.L. Boeker, and J.I. Hodges. In press. The authentic American eagle. *In* Bald Eagles of Alaska. P. Schempf, ed. University of Alaska Press, Juneau, Alaska.

This paper explores the foraging ecology and population dynamics of bald eagles along the northwest coast of North America.

Hansen, A.J., and F. di Castri, editors. In press. Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. Springer-Verlag Ecological Studies Series, New York.

Ecological studies have traditionally focused on rather homogeneous natural systems to minimize the complicating effects of adjacent systems. The transition zones between ecological systems may, however, strongly influence landscape characteristics. This book explores the effects of ecotones on biodiversity and the flows of materials, energy, and organisms.

Hansen, A.J., J.A. Peterson, and E. Horvath. 1991. Responses of vertebrates to stand and edge type in managed forests of the Oregon Coast Range. Northwest Environmental Journal 6:418-419.

This abstract summarizes the rationale and methods of this COPE study.

Hansen, A.J., T. Spies, F. Swanson, and J. Ohmann. 1991. Conserving biodiversity in managed forests. BioScience 41(6):382-392.

This paper synthesizes several previous studies and compares forest structure and composition in natural and managed forests. Implications for management and conservation are explored.

Hansen, A.J., P. Risser, and F. di Castri. In press. Epilogue: Biodiversity and ecological flows across ecotones. *In* Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. A.J. Hansen and F. di Castri, eds. Springer-Verlag Ecological Studies Series, New York.

This chapter synthesizes and evaluates earlier chapters in the book.

Hansen, A.J., and D.L. Urban. In press. Avian response to landscape pattern: The role of species life histories. Landscape Ecology.

Animals respond to habitat patterning according to their individual energy requirements, home range sizes, dispersal rates, and other life-history traits. This paper tests the hypothesis that life-history traits may differ between animal communities in different geographical locations.

Hansen, A.J., D.L. Urban, S. Garman, B.R. Noon, and W.C. McComb. 1991. Responses of wildlife habitats to forest management and climate change: A modeling approach. Northwest Environmental Journal 6:419-420.

This abstract summarizes the rationale and methods of this COPE study.

Hansen, A.J., D.L. Urban, and B. Marks. In press. Avian community dynamics: The interplay of landscape trajectories and species life histories. *In* Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. A.J. Hansen and F. di Castri, eds. Springer-Verlag Ecological Studies Series, New York.

This chapter uses simulation models to examine how bird species diversity responds to three different paths of landscape change: forest fragmentation, forest conversion to plantations, and abandonment of agricultural lands.

McComb, W.C., and A.J. Hansen. In press. An introduction to forest wildlife ecology. *In* A Silvicultural Approach to Animal Damage Management in the Pacific Northwest. H. Black, ed. USDA Forest Service, Pacific Northwest Experiment Station, Portland, Oregon.

This chapter provides a conceptual overview of aspects of wildlife ecology that are relevant to the management of animal damage.

Tucker, G.F., and J.R. Powell. 1991. An improved canopy access technique. Northern Journal of Applied Forestry 8:(1)29-32.

This paper discusses several canopy access techniques and describes a preferred new method for climbing trees with elevated crowns and broad upright branches—for example, stand-grown deciduous trees.

NEWSLETTER

The *COPE Report* was mailed to over 2,000 subscribers this year; this report rapidly disseminates research findings, announces upcoming educational opportunities, and highlights recent publications and topics of interest. The newsletter thus consistently and effectively informs cooperators and other interested persons about COPE activities and about general developments in resource management. This year's four issues are reprinted in the Appendix.

WORKSHOPS

This past year the Adaptive COPE team held two major workshops—one was a conference on the OSU campus and the other a field trip in the mountains of southwestern Oregon.

MANAGING FOREST BIODIVERSITY: A COASTAL NORTHWEST PERSPECTIVE

July 11-12, 1991. Oregon State University. About 200 participants.

The conservation of biological diversity has become a major issue on public and private lands in the United States. Various federal and state laws require that native plant and animal species be maintained on public lands. Even private land owners are increasingly required to mitigate negative impacts of resource development on species diversity. These laws are founded on the premise that native species have value. They may yield foods or medicines, play crucial roles in ecosystem functioning, or have high aesthetic value. Less tangible elements of biological diversity related to gene pools, ecosystems, and landscapes have not yet been fully integrated into legislation. Nonetheless, conservation of these elements is a management objective on many public lands.

Interest in maintaining biodiversity has grown more rapidly than have methodologies for managing it. Developing such approaches will require answers to several difficult questions. What is biological diversity and which elements of biodiversity merit greatest attention? How can we best deal with the multitude of species in Northwest forests? What tools exist for projecting the responses of species and landscapes to various management scenarios? How can we monitor biological diversity to determine whether management strategies are successful?

Approximately 200 forest managers and scientists gathered at Oregon State University on July 11-12, 1991, to address these and related questions. The introductory session explained what biodiversity is, why it is important, and the legal directives for preserving it. The second session examined and evaluated approaches that federal, state, and private organizations are using to manage biodiversity. Several "next generation" approaches for managing biodiversity were presented in the third session.

Among the important points that emerged from the presentations and discussions were:

- Biodiversity is an extremely broad concept; hence management objectives must be very carefully stated to provide clear direction for management prescriptions and monitoring.
- Considerably more information is needed on factors controlling patterns of biodiversity and the impacts of various management practices. Essential are both formal scientific research projects and field testing of a range of prescriptions.
- Biodiversity is expressed over a range of spatial and temporal scales, and consequently researchers and managers need to consider factors at the microhabitat, stand, watershed, and regional levels.
- The scope and complexity of managing biodiversity exceed the capacity of individual institutions; thus success will hinge upon unparalleled cooperation between industry, government agencies, private institutions, and academic organizations.
- It is the appropriate role of scientists and foresters to develop and implement systems for managing biodiversity. Ultimately, however, it is up to society to determine public policy on the conservation of biodiversity.

Copies of the workshop notebook are available from the Conference Office, College of Forestry, Oregon State University, Corvallis, OR 97331.

MANAGING FOREST BIODIVERSITY WORKSHOP

DAY ONE

Introduction: Moderator—S. Hobbs, COPE

Welcome: A. Hansen, COPE and OSU

An Introduction to Biodiversity: D. Perry, OSU

Legal Approaches to Protecting Biodiversity: D. Rohlf, Lewis & Clark College

Management of Biodiversity in Practice: L. Irwin, NCASI

Current strategies for managing biodiversity: Moderator—A. Hansen, COPE and OSU

Forest Service Regional, Forest, and District Level Strategies: T. Tolle and B. Marcot, USFS

Shasta Costa Project, Case Study: R. Steed, USFS

Trail Creek Project, Beaverhead National Forest, MT: J. Morrison, USFS

A Strategy for Biodiversity on BLM Lands in Western Oregon: R. Kaufman, BLM

Medford BLM District Case Study: R. Lewis, BLM

Private Industry Perspectives: J. Rochelle, Weyerhaeuser; L. Hicks, Plum Creek Timber Company

Oregon Department of Fish and Wildlife's Gap Analysis Project: B. Cutsi, ODFW

Oregon Department of Forestry: L. Jones, ODF

Panel Discussion Evaluating Current Approaches: L. Burditt and B. Marcot, USFS; A. McKee, OSU; B. Naiman, UW

DAY TWO

Approaches currently under development: Moderator—D. Perry, OSU

Comprehensive Approaches for Managing Wildlife Diversity: A. Hansen, COPE and OSU

Comprehensive Approaches for Managing Diversity: Silvicultural Perspectives: W. McComb, J. Tappeiner, and W. Emmingham, OSU; T. Spies, PNW

Comprehensive Approaches for Managing Diversity: The Fish's Perspective: P. Bisson, Weyerhaeuser; G. Reeves, PNW

Invertebrate Biodiversity Management Priorities: A. Moldenke, OSU

The Role of Simulation Modeling in Projecting Future Patterns in Landscapes and Biodiversity: S. Garman, COPE and OSU

Managing Biodiversity under Climate Change: R. Neilson, EPA

Panel Discussion Evaluating Next-generation Approaches: R. Kiester and G. Reeves, PNW; R. Kaufman, BLM; J. Rochelle, Weyerhaeuser

Conclusion: **Synthesis and Future Prospects:** B. Naiman, UW

LANDSLIDES, FISHERIES, AND FORESTRY IN SOUTHWEST OREGON: A FIELD TOUR

June 10-12, 1991. Gold Beach, OR. 61 participants.

Steep, unstable slopes in the geologic setting of southwest Oregon are particularly prone to landslides. In addition to other effects, mass failures can dramatically affect fisheries. State-of-the-art practices can allow steep, forested land to be effectively managed. However, making the best decisions on issues affecting slope stability requires knowledgeable field personnel.

Field-level resource professionals who regularly make such decisions in southwest Oregon were the target audience for this workshop. The workshop provided participants with information that will help them identify potential slope stability problems as they lay out roads and harvest units. Although these field workers will not have the expertise to fully evaluate problems, technical specialists can be called when specific recommendations are needed.

The workshop began with general information about the geology of southwest Oregon, including geomorphic processes and unstable landforms. The group then toured specific sites that demonstrated common hazards in the region. In addition, management alternatives for unstable landforms were discussed, with particular emphasis on the effects of landslides on fisheries.

SOUTHWEST OREGON FIELD TOUR

DAY ONE

Welcome and Introduction: A. Skaugset, Adaptive COPE

Overview of the Fisheries of Southwest Oregon: D. King, Siskiyou National Forest

Overview of the Geology of Southwest Oregon: J. Cornell, Siskiyou National Forest

DAY TWO

Overview of Landslide Processes in Southwest Oregon: C. Ricks, Siskiyou National Forest

View of Hunter Creek Failure: R. Van Dyke

View of Pine Point Rock Quarry and South Fork Hunter Creek: E. Gross and C. Ricks, Siskiyou National Forest; C. Jasper, Soil Conservation Service

View of Gully Features, Outcrops, and Inner Gorge at Quosatana Creek: E. Gross, D. Mickley, and C. Ricks, Siskiyou National Forest

DAY THREE

View of Silver Creek Instream Enhancement Structures and Overview of Fish Habitat: D. Harris, ODFW

View of Moorsky Earthflow: E. Gross and C. Ricks, Siskiyou National Forest; C. Jasper, Soil Conservation Service

Workshop Summary and Closing Remarks: A. Skaugset, Adaptive COPE

PRESENTATIONS

During the past year, Adaptive COPE team members gave a number of formal and informal presentations about COPE research and technology transfer activities to a wide cross-section of audiences, including:

> Visiting forestry faculty and forestland managers from Norway; visiting officials from Regional and National offices of the Bureau of Land Management and representatives of the Sport Fisheries Institute and Outdoor Life Magazine; visiting staff from the Corvallis campus of OSU College of Forestry.

In addition, the following technical presentations were given:

Garman, S., A. Hansen, and D. Urban. 1991. Assessment of wildlife-habitat diversity under alternative forest-management practices: A simulation approach. New Perspectives Conference, USDA Forest Service, Olympic National Forest, Olympia, Washington.

Garman, S. 1991. The role of simulation modeling in projecting future patterns in landscapes and biodiversity. Workshop: Managing Forest Biodiversity: A Coastal Northwest Perspective, LaSells Stewart Center, Oregon State University, Corvallis, Oregon.

Hansen, A. 1990. Effects of natural disturbance and management on forest wildlife communities. University of Washington, Seattle, Washington.

Hansen, A. 1990. Managing biological diversity. Annual meeting of Washington Farm Forestry Association, Olympia, Washington.

Hansen, A. 1990. Panel discussion on Managing Biodiversity, USFS Region 6 conference on Biodiversity, Spokane, Washington.

Hansen, A. 1991. A comprehensive strategy for managing wildlife diversity. COPE symposium on Managing Forest Biodiversity, Oregon State University, Corvallis, Oregon.

Hansen, A. 1991. COPE studies on biodiversity. BLM meeting on Biodiversity, Salishan Lodge, Oregon.

Hansen, A. 1991. Effects of life-history traits and landscape patterns on species diversity. OSU Hatfield Marine Science Center weekly seminar, Newport, Oregon.

Hansen, A. 1991. Implications of landscape ecology for forest management. Stand Management short course, Oregon State University, Corvallis, Oregon.

Hansen, A. 1991. Implications of landscape ecology for wildlife management. Wildlife Habitat Relations class, Oregon State University, Corvallis, Oregon.

Hansen, A. 1991. Life history attributes and avian diversity: Scaling implications for global change. International Union of Biological Sciences symposium on Biological Diversity and Global Change, Amsterdam, The Netherlands.

Hansen, A. 1991. Managing biodiversity. Annual meeting of the northwest section of the Wildlife Society, Silverdale, Washington.

Hansen, A. 1991. Managing biodiversity. Meeting of USFS Forest Pest Management personnel, Salt Lake City, Utah.

Hansen, A. 1991. Managing biodiversity. Oregon State University short course on Managing Old-Growth Ecosystems, Blue River, Oregon.

Hansen, A. 1991. Modeling landscape and avian habitat dynamics. Oregon State University Zoology Department seminar. Corvallis, Oregon.

Hansen, A. 1991. Modeling three trajectories of landscape change. Annual meeting of the Ecological Society of America, San Antonio, Texas. Delivered by S. Garman.

Hansen, A. 1991. Role of vertebrates in ecosystems. Oregon State University Department of Forest Science Forest Ecosystem Analysis class, Corvallis, Oregon.

Hansen, A. 1991. Wildlife in managed forests. Annual meeting of Champion International, Ashland, Oregon.

Hansen, A. 1991. Wildlife response to edge effects. Pacific Northwest Research Station workshop on Landscape Ecology, Eugene, Oregon.

Hansen, A. 1991. Wildlife response to edge effects. Pacific Northwest Research Station workshop on Landscape Ecology, Portland, Oregon.

Skaugset, A. 1991. COPE Program overview. National Forestry Extension field tour, Eugene, Oregon.

Skaugset, A. 1991. The effect of large woody debris piece size and orientation on aquatic habitat: First year results. BLM administrators, OSU Hatfield Marine Science Center, Newport, Oregon.

Skaugset, A. 1991. Timber harvesting and landslides in the Oregon Coast Range. ODFW/BLM biologists, Coos Bay, Oregon.

Skaugset, A., D. Michael, K. Mills, and J. Seward. 1991. Recognition and investigation of landslide risk due to timber harvesting in Oregon Coast Range. Annual meeting of Council on Forest Engineering, Nanaimo, British Columbia.

Skaugset, A., J. Schroeder, and R. Rhew. 1990. The effect of debris piece size and orientation on aquatic habitat: A progress report. COPE Advisory Council, Eugene, Oregon.

Skaugset, A., J. Schroeder, and R. Rhew. 1991. Large woody debris and aquatic habitat: The effect of piece size and orientation. OSU Department of Forest Engineering seminar, Corvallis, Oregon.

COPE POSTERS

The four-panel COPE poster produced in 1989 has been displayed in a variety of settings this year. Posters have also been produced on "COPE Riparian Studies" and "Modeling Habitat Diversity Under Three Landscape Trajectories." Different combinations of these three posters have been displayed at several meetings, including the Society of American Foresters' national convention, the Olympic National Forest conference on the New Perspectives Program, the COPE workshop "Managing Forest Biodiversity: A Coastal Northwest Perspective," and the British Columbia Coastal Silviculture Committee field tour. When not at meetings, these posters hang outside the Adaptive COPE offices at the Hatfield Marine Science Center, where they are used during tours of the center. A second copy of the COPE program poster is displayed on a rotating basis in the center's public wing.

FIELD TOURS

Field tours are an important part of COPE's exchange of information with cooperators concerning resource management questions in the Coast Range. This past year, the Adaptive COPE team members toured field sites with the following groups:

> Oregon Department of Forestry—Astoria District, Bureau of Land Management—Salem District, Siskiyou National Forest, Starker Forests, Siuslaw National Forest.

CONSULTATION

Adaptive COPE's location in Newport means that staff members have ready contact with Coast Range resource managers. These informal contacts provide an important and effective way of exchanging information. Throughout COPE's fourth year, individual team members have participated in many informal discussions, field trips, and impromptu meetings. These contacts will continue to be a significant part of the Adaptive COPE goal of transferring information among researchers, managers, and the general public.

ORGANIZATIONAL ACTIVITIES

The Adaptive COPE team was involved in a number of committees formed to address resource management topics related to various aspects of the COPE program. These assignments included:

- Canopy Access System Steering Committee of the Olympic Natural Resources Center, University of Washington
- COPE Science Committee
- Forest Science and Technology Committee of the Oregon Chapter of the Society of American Foresters
- Oregon Department of Forestry Forest Road Drainage Working Group
- Scientific Advisory Committee of EPA Program on Global Change
- Technical Advisory Committee of the Siskiyou National Forest Shasta-Costa Planning Project

PLANS FOR FY 1992

RESEARCH

- Complete site selection and begin collecting pre-treatment data for Interdisciplinary Research and Demonstration Area Project (IRDAP).
- Continue studies listed on pages 3 - 18.

EDUCATION

- Publish four newsletters.
- Conduct a workshop on "Forest Road Drainage."
- Conduct two extension workshops on "Streamside Management and Erosion Control Techniques for Small Woodland Owners."
- Conduct a workshop on "Stream Survey Design and Methodology."
- Hold a regional symposium on "Assessment of Stream Habitat Inventory and Monitoring Programs."
- Produce a poster presentation on the Interdisciplinary Research and Demonstration Area Project (IRDAP).
- Prepare a manuscript on the effects of alternative silviculture on wildlife habitat.
- Prepare a manuscript on the results of the forest roads drainage survey.
- Continue consultations, field trips, and meetings with cooperators.
- Continue to increase public awareness of the COPE program.
- Produce an Adaptive COPE annual report.

BUDGET SUMMARY FY 1991

Approximate Expenditures		Revenue Sources	
Personnel	$286,980	Federal Agencies	$244,000
Services and Supplies	50,502	State Agencies	55,000
Travel	35,233	Industry	150,000
Equipment	14,725	Counties	33,600
Indirect Costs	15,744	Associations	200
		Carryover	37,460
Total	$403,184	Total	$520,260

ANTICIPATED BUDGET FY 1992

Approximate Expenditures		Revenue Sources	
Personnel	$367,000	Federal Agencies	$282,000
Services and Supplies	50,000	State Agencies	55,500
Travel	39,000	Industry	150,000
Equipment	50,000	Counties	16,500
Indirect Costs	23,000	Associations	200
		Carryover	117,076
Total	$529,000	Total	$621,276

APPENDIX

COPE REPORT

This is a quarterly newsletter highlighting COPE research activities, upcoming educational opportunities, and recent publications and topics of interest. To receive it, write or phone:

ADAPTIVE COPE PROGRAM
HATFIELD MARINE SCIENCE CENTER
NEWPORT, OR 97365
(503) 867-0220

COPE Report

Coastal Oregon Productivity Enhancement Program

Promoting Integrated Management of Oregon's Coast Range Forests
Through Research and Education

Volume 3, Number 4 Fall 1990

The COPE Program

The Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between Oregon State University's (OSU) College of Forestry, the USDA Forest Service Pacific Northwest Research Station (PNW), the USDI Bureau of Land Management (BLM), other federal and state agencies, forest industry, county governments, and the Oregon Small Woodland Association. The intent of the program is to provide resource managers and the public with information relative to the issues and opportunities associated with the management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. The COPE Program emphasizes an integrated approach—an integration of research and education and an integration of scientific disciplines—to find effective ways to manage these diverse resources collectively.

The COPE Program has two related components: Fundamental COPE and Adaptive COPE. Comprised of OSU and PNW scientists based primarily in Corvallis, Fundamental COPE addresses problems related to riparian zone management and reforestation in the Coast Range through basic research. Adaptive COPE is comprised of an interdisciplinary team responsible for applying and adapting new and existing research information to solve specific management problems. Stationed on the coast in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for providing continuing education opportunities to facilitate technology transfer.

Published quarterly, the COPE Report provides a means to rapidly disseminate research findings, announce upcoming educational opportunities, and highlight recent publications and topics of interest. Its goal is to foster good resource management by helping people involved in the management of Oregon Coast Range resources to stay well-informed. Comments and suggestions concerning the content of the COPE Report are welcomed and encouraged. To receive this free newsletter, contact COPE, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365. Phone: (503) 867-0220.

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6 OF INTEREST
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- 7 New Perspectives in Forestry
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11 OPPORTUNITIES

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ADAPTIVE COPE

Hatfield Marine Science Center
Oregon State University
Newport, OR 97365-5296
(503) 867-0220

SCIENTISTS

Andy Hansen, Wildlife
Tom McMahon, Fisheries
Arne Skaugset, Soils/Hydrology

RESEARCH SUPPORT

Doug Bateman
Steve Garman
Eric Horvath
Steve McConnell
Ron Rhew
Jim Schroeder

Newsletter Editor: Andy Hansen
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ADAPTIVE COPE

REFORESTATION OPTIONS WORKSHOP SUMMARY

Restrictions on traditional reforestation tools, especially prescribed burning and herbicide use, have led many resource managers to use alternative techniques. This workshop was developed to allow managers to share their experiences and to capitalize on recent research gains. The workshop featured eight presentations by field-level managers from private timber industry and government agencies, six presentations by researchers, and one presentation from a representative of an environmental group. Topics ranged from practical hands-on approaches to successfully managing forest land without fire or herbicides to evaluating the social, political, and economic context in which the success of reforestation efforts should or could be measured.

The second day of the workshop featured a field trip. Research by Bill Stein of the USDA Forest Service Pacific Northwest Research Station in Corvallis explained his research comparing six operational site preparation methods following clearcut harvest. The afternoon started with a summary of planting experiences under different site preparation techniques by Lee Miller, of Miller Timber Services in Philomath, OR. In particular, Lee addressed the effects of different site preparation techniques on planting cost, planting quality, and expected worker injury. This was followed by a look at research by Mike Newton and Liz Cole (OSU) on the effect of understory brush control and inter- and intra-specific competition of hemlock and alder at different densities.

The 125-member audience consisted mostly of field-level resource managers representing the timber industry, federal, and state agencies. Many participants commented that the field trip and some of the talks clearly showed the advantages of traditional techniques used in intensive forest management. Others were frustrated by what they felt was too great an emphasis on the traditional techniques, as the realities of their management situation, for better or worse, exclude those methods. They would have liked to see this workshop concentrate more on the range of options that exist outside the traditional techniques.

The comments received suggest that there is a great deal of interest in both traditional and alternative practices and that there is room to explore both of these at future workshops. The field trip approach was generally well liked, except that it necessitated limiting enrollment. COPE will explore the possibility for future workshops of having a day indoors with field trips the day before and the day after. This would double possible enrollment without sacrificing quality on the field day.

Overall the workshop was well received, but we are always looking to improve. Comments or suggestions relating to this or future workshops are welcome.

Steve McConnell,
Adaptive COPE

FUNDAMENTAL COPE

PNW AND OSU COOPERATE IN GIS

Geographic Information Systems (GIS) are now in place at the Corvallis Forestry Sciences Laboratory (FSL). Our hardware and software arrived in July 1989 and we expect to be fully operational sometime in the late summer or early fall, 1990. In the meantime, we're working on pilot studies and preparing data sets which we expect to be shared by multiple users.

Management Philosophy

Because there is considerable administrative and scientific overlap among FSL researchers interested in GIS analysis, the systems are administered jointly between the OSU Department of Forest Science and PNW Landscape Management Research Work Unit. We've been able to eliminate inconvenient administrative boundaries and provide a variety of software tools for landscape modeling and analysis.

Hardware

Our systems run on the OSU Forest Science SUN ethernet and the Forest Service Data General (DG) minicomputer. The Landscape Management and Fish Habitat PNW work units pooled some resources to provide a 4' by 5' back-lit Calcomp digitizing tablet for data capture and a Calcomp drum pen plotter for map products that are shared between the SUN and DG computers. Access to the software is available through three SUN workstations and a single Tektronics terminal on the DG.

Software

Since no GIS is able to provide all the analytical, cartographic, and data conversion capabilities we need (see COPE Report 2(3):8-10), we use three separate software packages that complement each other. Our workhorse software is Arc/Info which operates on the SUN. Arc/Info is a widely-used commercially-marketed vector-based software (which means that map features are represented by lines and points like most of the maps we use). Its strengths are in data entry and map editing, and in excellent cartographic output. The software also has good utilities for data format conversion, terrain data processing, and network analysis.

More powerful GIS analytical capabilities are available with GRASS, a public-domain package developed by the Corps of Engineers. GRASS is a raster based system in which map features are represented by grid cells. Raster processing is fast and provides a variety of analytical functions not available in vector systems, i.e., sophisticated neighborhood functions. Both GRASS and Arc/Info operate on the SUN system and the conversion between formats is straightforward. Together these two packages provide us with very complete GIS capability.

Our third software package is MOSS, a public-domain system developed by the USDI Fish and Wildlife Service over a decade ago. More recently BLM has supported a revision of the software through a commercial vendor and the national forests in Region 6 are using it as an interim system until a nation-wide Forest Service GIS is available in 1991 or 1992. MOSS supports both vector and raster processing. Many of us work directly with national forests on landscape analyses or models that we develop and they operate in their computing environment. By having MOSS available, we can develop our processes on one system, make sure it works in MOSS, and then transfer the data electronically to the national forests. MOSS operates on the Forest Service DG minicomputer.

Personnel

Our GIS staff is small. Currently we're able to provide users with assistance on analytical design, programming links between models and GIS, GIS database design, digital data acquisition, and training. Data capture, data entry, and analyses are left to the user. We're usually around to help and give advice. Here's who we are:

GIS Coordinator - George Lienkaemper. After spending nearly ten years as a geologist on the PNW Watershed/ Landscape Management project field crew, George began, in 1988, the process of bringing GIS to the Corvallis Forestry Sciences Laboratory. He's attended numerous workshops and training sessions in using both MOSS and Arc/Info systems. For a year he was part of the Region 6 GIS Cadre which conducted workshops to help the national forests prepare for the introduction of GIS technology.

As a coordinator, George provides assistance in determining data needs, analytical design, data acquisition, and training. George also coordinates scheduling and serves as a GIS analyst for the Landscape Management project.

Technical Support Programmer - Barbara Marks. Barbara joined the staff in December from a programming position in the OSU departments of Biochemistry and Biophysics. Before coming to Corvallis 18 months ago, Barbara (a University of California-Santa Barbara Geography graduate) worked in programming for 8 years at the Santa Barbara Research Center (SBRC) - part of Hughes Aircraft. While at SBRC she had experience with image processing, evaluating data from Thematic Mapper and MSS satellites. Before leaving SBRC, Barbara managed software that evaluated the effectiveness of remote sensing detectors developed by Hughes.

Barbara is an excellent programmer, fluent in Fortran and C. She is able to provide a variety of programming assistance from landscape model development to linking models to GIS. Barbara can also help in preparing GIS macros and will be developing a user interface (menus) to make using our systems much easier.

GIS Database Manager - Hazel Hammond. Hazel has worked in database management for two years as part of the PNW Landscape Management project. Trained as a Geologist, Hazel came to the PNW from the US Geological Survey. Last fall she attended a GIS/Remote Sensing training session sponsored by LTER and has more recently been working on a variety of GIS pilot projects.

Hazel helps with GIS database design and documentation. She has considerable experience with the Forest Science Data Bank and makes certain GIS data sets conform to FSDB requirements. Hazel also maintains the GIS data dictionary - a reference that documents GIS data sets and is essential to have at your side during analysis. As our database expands, Hazel will also maintain our GIS map Library.

Support

Initial funding for the SUN workstations and Arc/Info software was provided by the National Science Foundation through the Long-Term Ecological Research grant. PNW research work units have provided some hardware peripherals. OSU Dept. of Forest Science, LTER, COPE, and PNW all are providing ongoing funding for system support, staff, software licensing, and system upgrading.

A Final Word

GIS is becoming an important tool in resource management and landscape modeling and analysis. Having the technology available provides the capability to do some things not possible before. Just like any computer application, however, information that comes out of a GIS is only as good as the data that go in. This new technology has tremendous potential, but to obtain maximum benefit from GIS, we must keep in mind its limitations.

George Lienkaemper,
PNW

INFLUENCES OF RIPARIAN VEGETATION ON SMALL MAMMAL, AMPHIBIAN AND REPTILE COMMUNITIES

The importance of riparian forests to small mammals, amphibians and reptiles is yet to be fully determined in the Pacific Northwest. The cool moist microclimates of riparian areas may be important to some vertebrates and provide essential resources for other species. Since the distribution and abundance of these animals depends to a large degree on the vegetation characteristics of an area, the impact of the alterations induced by timber harvests within riparian habitat needs to be determined. Small mammals, amphibians and reptiles likely have an important role in many forest food chains because they are abundant members of the vertebrate community. The purpose of this project is to determine the importance of riparian habitat to these animals and to describe differences in their species composition and relative abundance in a variety of forest types.

Study Methods

Study sites were located within several watersheds in the Oregon Coast Range (Siuslaw National Forest) along second and third order streams. Fifteen study sites were placed in five forest seral stages (three replicates each) including: shrub, open sapling-pole, large saw timber, old growth, and deciduous types (Hall et al. 1985). Two 200-m transriparian, one 350-m riparian transect, and one 350-m upslope transect in a box arrangement were sampled per site. A total of 900 pitfall traps (60 at each site) were located at 25-m intervals along the transriparian transects and at 50-m intervals along the upslope and riparian transects. Results from a pilot study (McComb et al. 1991) indicated that pitfall traps were more efficient than other common methods for sampling both small mammals and herpetofauna. This is a two-year study with two trapping seasons per year, one during the cool, moist (May-June) and one during the hot, dry season (August-September). This article reports on results from the 1989 field season.

Preliminary Results

During 1989, we trapped a total of 2,438 mammals and 240 herpetofauna during the spring and summer seasons. Three rodent species (creeping vole, deer mouse, and Pacific jumping mouse) were caught most frequently in the shrub habitats (Table 1). This supports the findings of past studies which have found these species to be associated with herbaceous vegetation. There were large differences in relative abundance of the red-backed voles, with significantly higher numbers caught in the large-saw and old growth stand types. All red tree voles were caught in old growth stands. In contrast, four of the insectivore species (shrew-mole, coast mole, vagrant shrew, and Trowbridge's shew) and three amphibians (redback salamander, red-legged frog, and the roughskin newt) showed a strong association with the deciduous sites. The Pacific water shrew and the tailed frog were captured more frequently in mature conifer forests, and vagrant shrews were common in shrub habitats.

Three species (Pacific water shrew, jumping mouse, and the tailed frog) showed a strong association with riparian areas (Figure 1) and are candidates for riparian obligates.

Table 1. Numbers of small mammals and amphibians captured on five forest types in the Oregon Coast Range, 1989.

Species	Shrub	Pole	Large saw	Old growth	Deci-duous	Totals
Rodents:						
Western red-backed vole	13	5	57	44	0	119
Creeping vole	8	1	4	3	0	16
Red tree vole	0	0	0	5	0	5
Deer mouse	13	1	3	1	5	23
Pacific jumping mouse	122	23	33	10	40	228
Insectivorous Mammals:						
Shrew-mole	11	2	4	7	23	47
Coast mole	0	2	1	7	10	20
Pacific water shrew	19	13	43	27	22	124
Vagrant shrew	19	1	5	2	19	46
Trowbridge's shrew	150	253	252	213	380	1248
Amphibians:						
Tailed frog	1	0	18	12	4	35
Redback salamander	8	5	14	12	32	71
Red-legged salamander	0	1	0	0	8	9
Roughskin newt	0	5	6	9	53	73

The higher numbers of jumping mice in the shrub types suggests an association with the grass-forb vegetation often found in shrub and riparian habitats alike. Morrison and Anthony (1989) suggested that the jumping mouse showed little use of the evergreen shrubs; however they might have an association with dense grass cover on early-growth clear-cuttings in western Oregon. The red-backed vole, in contrast, was the only species with a strong association with upslope areas in mature or older forests. This supports a conclusion that this species prefers older contiguous stands of mature forest.

Please keep in mind that these are the preliminary results of the first of a two-year study. In the final analysis we hope to obtain a better idea of which species, if any, are riparian obligates and to identify some of the microhabitat components with which these species are associated.

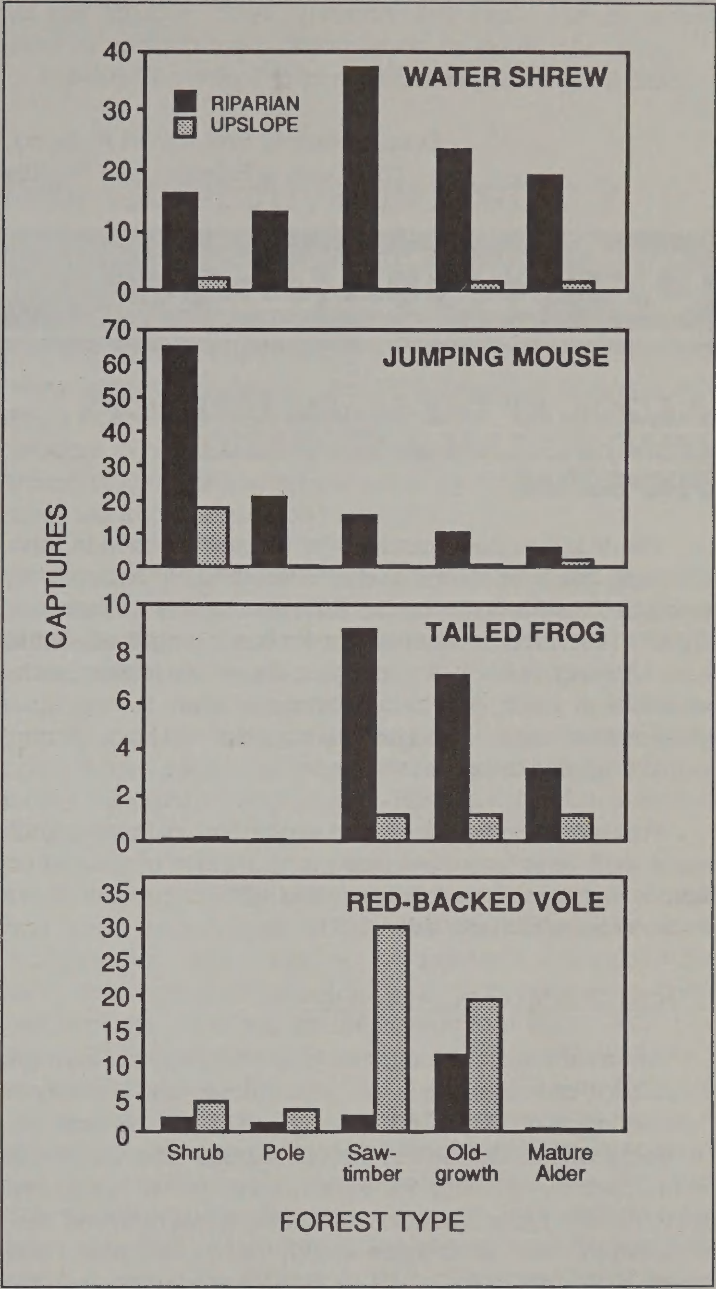

Figure 1. Numbers of water shrews, jumping mice, tailed frogs, and red-backed voles captured in riparian (solid bars) and upslope (cross-hatched bars) areas in five forest types, 1989.

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Douglas Gomez and Robert Anthony,
OSU Dept. of Fisheries and Wildlife

OF INTEREST

A LOOK AT THE SALEM DISTRICT'S (BLM) STREAM RESTORATION PROGRAM

The BLM has been active over the past decade in rehabilitating fish habitats within degraded streams. Two recently published BLM technical notes (House et al. 1989, House and Crispin 1990) offer many reasons for continuing these activities. Among them is the fact that the projects seem to be effective in improving fish habitat. Another is that these projects illustrate to managers the importance of maintaining natural habitat structure in streams.

Past rehabilitation efforts and evaluations of these projects have lead us to improved designs, materials, and construction techniques. The following is a quick summary of our evaluations which started in 1981.

Evaluation Techniques

We evaluated 15 restoration projects in terms of changes in habitat characteristics, fish populations, and stability of rehabilitation structures. Monitoring has continued from 1 to 10 years, depending on the project. Habitat assessment was conducted by dividing the channel into pools, riffles, and glide habitat types. For each habitat unit, we recorded area and depth, volume of large woody debris, dominant substrate, and vegetation cover type. Densities of juvenile fish were determined in summer by electroshocking and/or pole seining selected stream subsections. These data were then multiplied by the total area of each habitat type of treated reaches to obtain a population estimate for the entire stream section. Counts of adult fish and spawning nests (redds) were usually made weekly in fall. Artificial stream structures were surveyed after the first year of placement and/or after flooding events. Data collected on structures included: type, location, material, size, shape, and success.

Costs

Costs of artificial stream structures varied depending on access, materials, and equipment. Generally, wood and boulder structures fully spanning the channel ranged from $200-$600 where access was good to $800-$1,200 in remote areas. Structures which only partially span the channel are somewhat less expensive: deflecting logs cost about $140-$200 to install and boulder groupings about $5-$50. Secondary channel construction costs around $1.50 per linear foot.

Performance of Stream Structures

Habitat characteristics of streams changed substantially following treatment. Stream surface area generally increased about 2 m² per meter of stream, and water volume increased about 1 m³ of water per meter of stream. Pool habitat generally doubled in area, with major increases in dam, plunge, and backwater pool types. Structures installed in channels ranging from 3-11 meters in width created pool habitat that averaged less than 100 m², while structures in channels ranging from 14-20 meters in width created pool habitat that averaged 200 m² to 1,000 m² in area.

For example, 2.4 miles of Elk Creek (Nestucca River drainage) was treated with over 500 log structures resulting in dramatic changes in the types and amounts of habitat (Table 1).

Table 1. Water surface area (m²) in Elk Creek before (1985) and after (1990) stream restoration. Flow levels were similar in 1985 and 1990.

	Treated (2.4 miles)		Control (0.3 miles)	
Habitat types	Pre	Post	Pre	Post
Pools	3,378	18,334	842	441
Glide	3,249	3,546	308	98
Riffles	7,533	11,780	1,515	2,329
Total	14,260	33,660	2,665	2, 868

While the control reach lost pool habitat and total surface area remained similar following the treatment, the manipulated reach showed over a fivefold increase in pool habitat and the surface area more than doubled.

Densities of juvenile fish in summer varied among projects, depending on the channel width and intensity and types of treatment. Generally coho salmon showed the biggest increases and cutthroat trout yearlings changed the least. After treatment, coho juvenile densities in summer showed average increases of 7.4 fish per meter of stream, while cutthroat trout yearlings had average increases of 0.4 fish per meter. Coho salmon juveniles showed substantial increases in streams with channels greater than 12 meters, while steelhead and cutthroat trout yearlings had the greatest increases in channels ranging from 12 to 16 meters wide. It appears that streams treated with many full-spanning structures consisting mostly of wood had the highest responses, especially for coho salmon and steelhead.

Numbers of adult fish and area of spawning habitat substantially increased in treated areas. Moreover, the East Fork Lobster Creek Project, which has been monitored for ten years, showed a thirteenfold increase in coho salmon production when numbers of returning adults in the treated stream were compared to those in the nearby control stream.

Future Recommendations

Evaluation of our rehabilitation projects has revealed some important facts which will aid in planning, constructing, and managing future projects and riparian zones. Full-spanning structures of about one meter in height will create the most preferred coho salmon rearing habitat. It is crucial that sufficient cover/scour logs and/or boulders be placed in pools created by full-spanning structures to maintain adequate pool depth and volume over time.

A variety of structures should be concentrated in each reach to provide a complexity of spawning and rearing habitats. Natural materials are more aesthetically pleasing, less costly, longer lasting, and create better habitat conditions than unnatural materials. Although rehabilitation has benefitted salmonids in all stream sizes, structures installed in 11 to 18 meter channels create the most preferred habitat and potential salmonid production. Although stream rehabilitation generates benefits, it is costly in accessible stream reaches and infeasible elsewhere. This suggests that managing our riparian zones for optimum numbers of mature conifers for natural debris input is often the most desirable method of rehabilitating streams.

Conclusions

Stream rehabilitation work seems to have achieved structural, habitat, biological, and economic success. The restructuring of degraded stream reaches appears to have reversed channel downcutting and straightening in treated areas, creating significant increases in preferred salmonid habitat. Based on our evaluations, components such as gravel substrate, instream cover, pool habitat, total usable habitat, and water volume have all increased after debris placement in debris-poor streams.

In spite of these successes, we feel that the best long-term and least costly method of rehabilitating our streams is through an aggressive riparian management policy that provides a buffer zone capable of growing optimum numbers of conifers along all streams used by salmonids.

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Robert House and Val Crispin,
BLM

NEW PERSPECTIVES IN FORESTRY

The USDA Forest Service New Perspectives Program involves finding ways to manage forestland ecosystems for sustainability of all their values and uses. It was formed to help implement new direction for environmentally sensitive resource management in the 1990 Resource Planning Act (RPA) Program and the new Forest Plans. This direction is in response to new scientific knowledge about ecosystem functioning and the changing values of the American people on how their forests should be managed.

As is often the case in a large, decentralized organization, the Forest Service first responded to the need for change at the field-level, i.e., Ranger Districts and Forests. Through public participation and integrated resource planning, district projects and forest plans started to pay more attention to long-term productivity and ecological sustainability. Managers started searching for practices that would maintain a more ecologically-intact forest, while still providing sufficient timber yields.

Practices currently being tested include retaining snags and green trees in harvest units that would have been normally clearcut and laying out harvest units to minimize the short-term fragmentation of old-growth stands. Both these practices are occurring on the Blue River Ranger District in the Willamette National Forest. In the Shasta-Costa Project on the Gold Beach Ranger District of the Siskiyou National Forest, Forest Service, industry, and environmental groups are collaborating to develop a landscape-scale demonstration of timber harvesting that retains much of the plant and animal diversity of a drainage. Although these districts have been identified as leaders in the New Perspectives movement, it would be difficult to find a Ranger District in the Pacific Northwest that is not using New Perspectives thinking in their project design.

The principles of the New Perspectives path are evolving. The forest planning effort and the projects that implement the new direction in those plans are the key to this evolution. Plans begin with the aim of meeting people's needs for resources with greater attention to environmental quality–what the RPA Program calls "environmentally sensitive resource production." This emphasizes protection of water quality, fisheries, soils, and the diversity of plants and animals in a region.

A cornerstone of New Perspective practices is collaboration with people interested in, or affected by, proposed management activities. You might think of it as extending the interdisciplinary team concept to a broader array of people.

Another principle is integration of actions up and down geographic scales. It is not possible to meet all goals on all acres at all times. Therefore, the multiple values and multiple uses of a large area are planned and scheduled to better complement one another. Technologies such as geographic information systems and cumulative effects analysis models are essential in this landscape process. Finally, managers must design and carry out their actions in ways that provide better opportunities to learn from the results. This means bringing scientists into more active roles in building the knowledge base for ecosystem management and designing management strategies and actions, then following through with implementation, monitoring and evaluation. This approach is called adaptive resource management by its practitioners. To this end, a national research program in ecosystem science is unfolding in fiscal years 1991 and 1992.

The Chief of the Forest Service created the New Perspectives program in February of 1990 to guide the agency's transition to more environmentally sensitive resource management. Although stimulated by Jerry Franklin's "New Forestry," the Chief wants New Perspectives to encompass all wildland ecosystems and include social values as well as ecological considerations. He appointed Hal Salwasser, an ecologist for the agency since 1978, as Director. Hal has a core team of three assistant directors for conservation, research, and communication, respectively. The role of the core team is to help field units develop research and management projects that demonstrate Forest Plan and RPA direction through the principles of New Perspectives mentioned above.

In the Pacific Northwest, Region 6 and the PNW Research Station have organized a New Perspectives effort under a 10-year Research, Development, and Applications Program (RD&A) called "New Perspectives in Forestry." The Program is currently identifying its research, development, and application focus and determining how it will be integrated with management demonstrations on the national forests.

Dean DeBell and Marty Raphael, at the Forestry Sciences Laboratory (FSL) in Olympia, are working with scientists and managers on stand-level problem analysis. Fred Swanson's project personnel at the Corvallis FSL are working on a landscape-level problem analysis. They are seeking input from a wide range of interested people. The RD&A program has engaged the "Social Consortium for Natural Resource Values" to provide the problem analysis for the social implications of implementing new perspectives. The consortium includes scientists from the University of Washington, Oregon State University, PNW Research Station, and a growing number of other social scientists interested in natural resources management. Richard Haynes's project personnel in the Portland FSL, are working on economic modeling for the program.

We expect to have the problem analyses in draft form by October for discussion with scientists and managers. As the RD&A Program prepares the research agenda, we wil be documenting and tracking the field testing and demonstration of New Perspectives.

We realize there is a lot of concern and uncertainty ove just what New Perspectives is. One thing it is not is "smoke-and-mirrors" to obscure business as usual. The direction o Forest Service programs is changing and the evidence o that change is already in place in the 1990 RPA Program and other existing plans and projects. Based on what we learn and how society's goals for the national forests change over the next few years, there will likely be more change t come.

As the New Perspectives Program evolves over the nex year, the Forest Service, with the help of its many partners, will shape the path to scientifically sound and environmentally sensitive management for all the values and use of ou rich forest lands.

John Henshaw,
PNW

AN APPROACH FOR EVALUATING STAND SIGNIFICANCE AND DESIGNING FOREST LANDSCAPES

Forest management decisions affecting old-growth and mature forests have become increasingly controversial. The qualities found in these stands include diverse wildlife and plant habitat, productive soil and hydrologic systems, a potential for conversion into high value wood products, and unique aesthetic and cultural values.

The pattern of old-growth and mature forests remaining on the landscape is highly variable. In some places only isolated small patches (5-50 acres) remain; in other places larger blocks (>500 acres) remain. In Northwest National Forests managed for timber production, however, most of the remaining old-growth and mature forests are fragmented into various patch sizes and convoluted shapes.

This condition typifies the Upper Fall Creek planning area on the Lowell Ranger District, Willamette National Forest. Upper Fall Creek was selected as a prototype area to develop Forest Plan implementation processes for the Willamette National Forest. Project efforts began in early 1989. One of the major analyses undertaken was to evaluate old-growth and mature forest stand conditions and patterns over the entire 22,000 acre landscape. Most of the unharvested stands in the area are old growth. Past timber sale planning efforts on the Lowell Ranger District identified fragmentation of old-growth as a major issue. Alternatives that minimized further fragmentation were developed, and corridors to connect old-growth stands were located. However, the scale of these analyses was generally limited to 2,000-5,000 acres. At this more limited scale, the relative significance of old-growth and mature stands is difficult to discern, both in terms of stand values and the larger landscape values. Yet, in the attempt to locate timber sale units where they will have the least effect on old-growth and mature forest values, it is precisely these values that influence decision making.

Evaluating Old-Growth and Mature Stands

Our objective was to develop a landscape-level context for assessing the relative values of old-growth and mature forest. The existing stand condition inventory proved to be too general for project-level interpretations. Accordingly, the first task was to supplement our inventory and database with extensive "walk thru" surveys and quick plots focused on basic stand and site characteristics.

Next, we delineated blocks of old-growth and mature forest based upon topographic factors, stand conditions, and the degree of stand fragmentation. Major ridges and streams separated different vegetative and hydrologic systems. Major differences in stand conditions, e.g., an edge between fully developed old growth and a 120-year-old stand, were also used to form blocks. To evaluate fragmentation, the edge effects of surrounding openings upon mature and old-growth stands were approximated with a 400 foot buffer (approximately two tree heights). This was done because edge effects of increased light, heat, and wind penetration from surrounding openings are thought to alter plant and animal habitat along the forest edge. The resulting map of interior forest conditions helped separate relatively intact blocks from more fragmented blocks. All of these factors were integrated to form a map of old-growth and mature forest blocks ranging from forty to several hundred acres in size.

The value of these forest blocks was assessed using a numerical rating system based largely upon ecological criteria. We identified approximately fifteen potentially relevant criteria; five of these proved to be most relevant and operationally feasible at this scale. They were:

1. The presence of old-growth characteristics (large Douglas-firs, a multi-layered canopy containing some shade tolerant species, large snags, and large fallen trees).
2. The amount of interior forest habitat.
3. Landscape position (an isolated patch or an entire small watershed).
4. The presence of unique features (very large or old trees, unique mixes of plant associations, or unique structural features).
5. Extent of human intrusion (presence or absence of old roads, stumps, views of fragmented landscapes, etc.).

This last criterion was an attempt to incorporate a cultural or aesthetic perspective into the evaluation of old-growth values. Each block was rated for all five criteria and classified as high, medium, or low in volume based upon the total score.

The next step was to place these forest blocks into the larger landscape context. The blocks with the highest rating were placed on a map along with the pattern of special management areas designated in the Forest Plan (e.g., Special Interest Areas or Spotted Owl Habitat Areas). These forest tracts represent the hubs and nodes of a potential landscape network of old growth and mature forest. With these areas as the focal points, connecting corridors were identified (Figure 1). Providing pathways between the network nodes may help facilitate dispersal of some plants and animals over time. Medium rated blocks and connecting corridors were then placed onto the map and coded accordingly.

Results from this process established the relative significance of old-growth and mature forest blocks for either: (a) retention of old-growth and mature stand values for some period of time, or (b) timber harvest that would minimize the effects on old-growth or mature forest values. Conducting the analysis over an area large relative to timber sale areas allowed consideration analysis of larger landscape patterns.

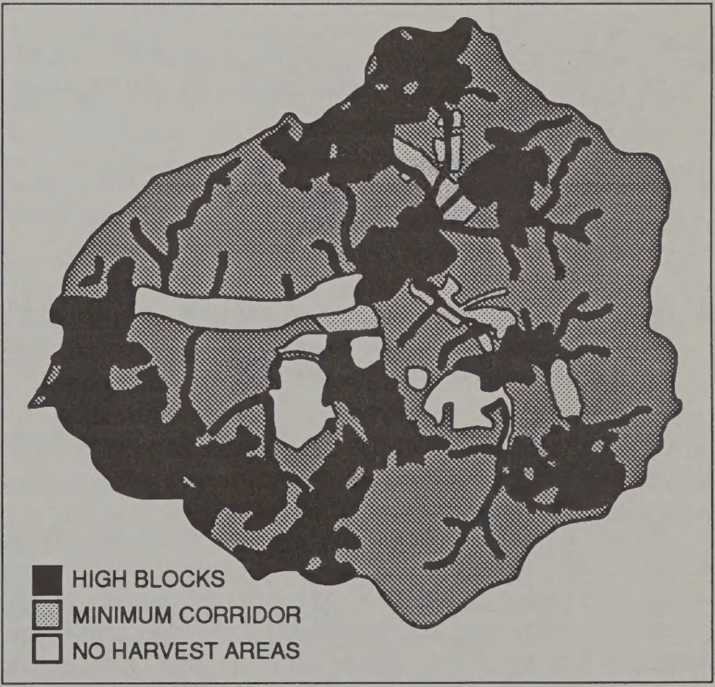

Figure 1. Map of planning area showing mature and old-growth stands rated as high in value, special management areas designated by the Forest Plan, and connecting corridors.

Evaluating Timber Harvest Patterns Over Time

The analysis described above established a set of priorities within a landscape scheduled for timber harvest. But does it really mean anything if the stands are scheduled for harvest at some point anyway? Are there alternative patterns of harvest in the short and intermediate terms (the next 10 or 20 years) that will significantly affect resource values in the landscape? If so, how will those patterns differ in their effects, and over what periods of time?

To address these questions, we embarked on a timber harvest scheduling analysis. Using concepts developed and tested on the Blue River Ranger District, Willamette National Forest (see COPE Report 3(1):8-11), we defined two scenarios: staggered-harvest settings and minimum-fragmentation settings. Additionally, we evaluated a third scenario as an extension of the minimum fragmentation approach. In the first two scenarios the blocks and connectors were identified within each 2,000 to 5,000 acre drainage independently. In the third scenario, the landscape pattern of old growth was used as a template for applying the minimum fragmentation approach across the entire 22,000 acre landscape. Trade-offs between individual drainages were made to maintain the overall landscape pattern for as long as feasible. Additional objectives guiding the analysis included:

1. Maintaining large patches and connectors among stands in an unharvested condition for as long as possible in the minimum-fragmentation designs.

2. Dispersing harvest units through the watersheds according to traditional District practices in the staggered-setting design.

3. Simulating harvest patterns for staggered-setting and minimum-fragmentation designs through the remainder of the first rotation (approximately another 40 years).

4. Designing harvest patterns that can be implemented within current Regional guidelines regarding harvest unit size and total size of created openings.

5. Applying the same decadal harvest levels to all three landscape designs.

Results from these scenarios illustrate significant differences in the patterns and sizes of remaining unharvested stands and young plantations. The greatest differences appeared in comparing the staggered-setting and minimum-fragmentation scenarios; differences were also apparent in comparing the two minimum-fragmentation approaches. Figure 2 depicts the landscape patterns at the end of 30 more years of harvest under staggered-setting and minimum-fragmentation (landscape-based) approaches. Table 1 shows how long the high and medium rated blocks remained intact, were partially fragmented, or were mostly harvested for these three scenarios. All eight high rated blocks remained intact after the second decade in the landscape network approach, six remained intact in the 2,000 to 5,000 acre drainage based minimum fragmentation approach, whereas all eight were fragmented in the first two decades with the staggered setting approach. Choice of harvest pattern obviously has implications for old-growth and mature forest values through the next 20 to 30 years in this situation.

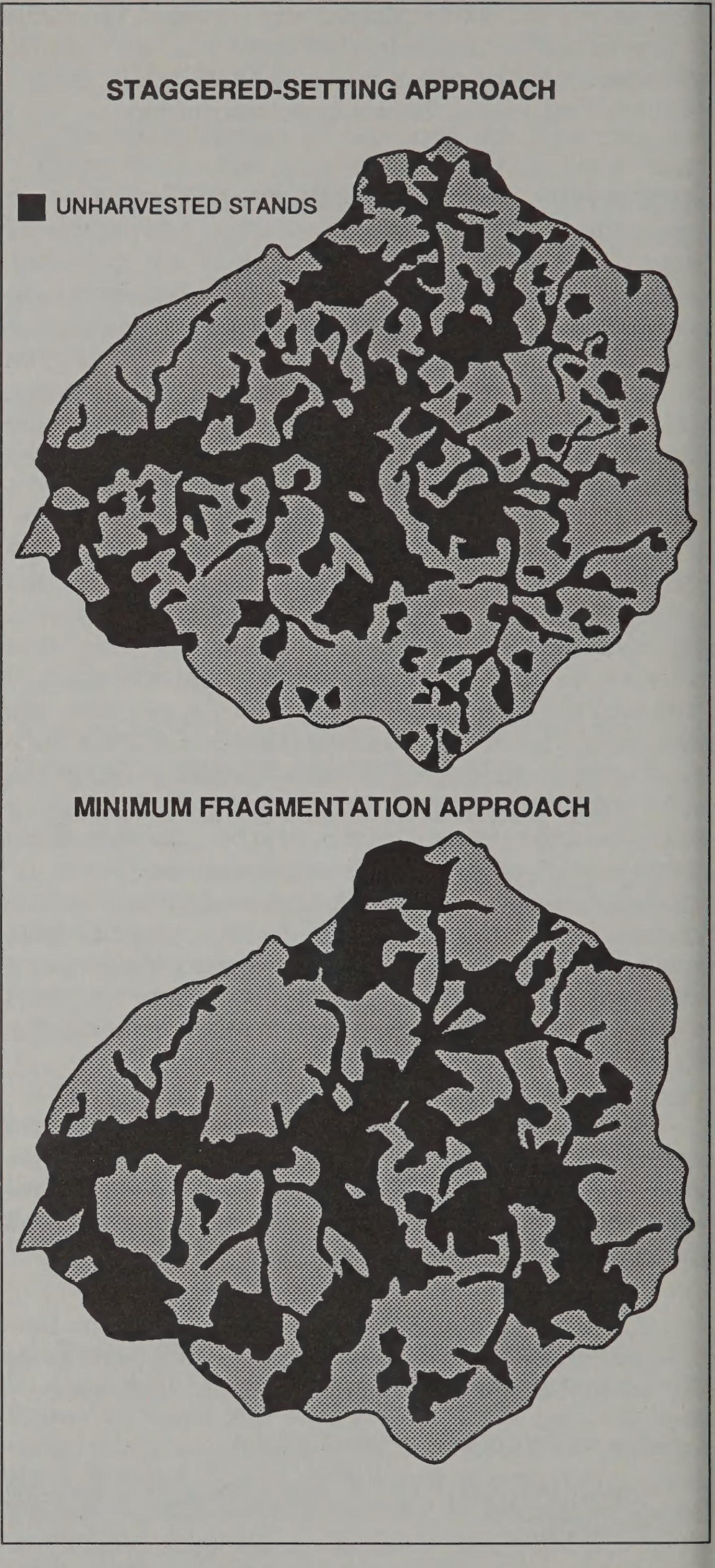

Figure 2. Landscape patterns in the study area under two different cutting patterns projected for 30 years beyond current patterns.

Table 1. Influence of three timber harvest scenarios[1] on old-growth and mature forest blocks (8 per rating) in the study area projected for the next four decades.

Forest blocks	Number of stands at end of decade											
	Decade 1			Decade 2			Decade 3			Decade 4		
	SS	DMF	LMF	SS	DMF	LMF	SS	DMF	LMF	SS	DMF	LMF
High rating												
# intact	1	7	8	0	6	8	0	2	5	0	0	1
# partially fragmented	6	1	0	3	1	0	0	4	3	0	3	5
# mostly harvested	1	0	0	5	1	0	8	2	0	8	5	2
Medium rating												
# intact	1	5	5	0	0	1	0	0	0	0	0	0
# partially fragmented	7	3	3	0	5	4	0	1	1	0	0	1
# mostly harvested	0	0	0	8	3	3	8	7	7	8	8	7

[1] SS = Staggered Settings; DMF= Drainage based Minimum Fragmentation; LMF= Landscape based Minimum Fragmentation.

Conclusions

This approach proved valuable for identifying relative old-growth and mature forest values and for displaying those values in a larger scale context for multi-resource decision making. We described an example of how this general process was applied to our planning area, but the general process may be applicable in other settings.

In situations where old-growth or mature forest values are high and options still exist within the current landscape pattern, an approach minimizing further fragmentation may be applicable. In many drainages where the harvest history is about midway through the first rotation, timber sale decisions made over the next decade may significantly restrict options for maintenance of interior habitat throughout the remainder of the current rotation. Moreover, implications of harvest pattern used in the first rotation extend beyond the existing old-growth or mature forest resource. We found that landscape patterns in the second rotation clearly reflected the imprint of cutting patterns in the first rotation.

Landscape management is still in an embryonic stage in the Northwest and the analysis identified several major questions needing critical thought and research:

1. What is an appropriate range of stand sizes for maintaining ecological values in natural forests?

2. What criteria should guide patch distribution over a landscape?

3. Do connective corridors really matter? For which species? What sizes and locations are most efficient and effective?

4. How can we maintain a mix of successional stages, including old growth stages, over time?

Clearly, many of the current stand-level questions, such as rotation age and structural diversity within managed stands, need to be evaluated within a landscape context. As usual, further work is needed!

John Cissel,
Blue River Ranger District
Willamette National Forest

OPPORTUNITIES

HOW TO DRY LUMBER FOR QUALITY AND PROFIT

December 3-7, 1990 **Corvallis, OR**

This course is designed for persons engaged in all aspects of dried-lumber production and is sponsored by the OSU Department of Forest Products. This includes kiln operators and supervisors, planer operators, superintendents and mill managers, and lumber salespersons.

The Lumber Drying course is taught by the Department's faculty and representatives from dry kiln and related-equipment manufacturers. The program includes classroom lectures, laboratory exercises, and hands-on demonstrations of modern control equipment.

Participants learn basic principles about how energy and water move through wood and how wood chemistry and anatomy affect drying. Information will be given on ways to dry lumber and maximize grade recovery, optimize costs and minimize kiln residence time. Modern kiln construction techniques, controllers and control strategies will be covered as well as moisture measurement methods and kiln schedule development. For more information contact the Conference Assistant, College of Forestry, OSU, 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

FOREST FERTILIZATION: SUSTAINING AND IMPROVING NUTRITION AND GROWTH OF WESTERN FORESTS

February 12-14, 1991 **Seattle, WA**

The Forest Fertilization Conference will summarize and synthesize research results and operational experience over the past decade relevant to forests in the western United

States and Canada. The program will include researchers and practitioners, and applied aspects of all topics will be stressed. Topics to be covered include: concepts in nutrient management for western forests; forest fertilization principles and practice; strategies for forest fertilization programs; and current issues in fertilization and nutrient management.

For further information, contact the Continuing Education Office, College of Forest Resources, University of Washington, AR-10, Seattle, WA 98195. FAX: (206) 685-0790.

RECENT PUBLICATIONS

THE COHO SALMON PUZZLE by Washington Department of Natural Resources and The Evergreen State College. 1989. This well-produced, 20 minute-long, videotape explores the life history and habitats of coho salmon throughout a large river basin. It focuses on the interrelationships of spawning and rearing habitats and on the importance of floodplains, wetlands and tributaries as winter habitat. Oriented towards resource managers, it explains how to identify, protect, and enhance valuable floodplain habitats. The story is told in a straightforward and informative manner appropriate for more general audiences, too. Available for a nominal fee from: Jeff Cederholm, Washington Department of Natural Resources, 9701 Blomberg St. SW, Olympia, WA 98504.

TM

USE OF RIPARIAN AND UPLAND HABITATS BY SMALL MAMMALS by A.T. Doyle. 1990. Journal of Mammalogy. 71(1):14-23. The use of riparian habitats by wildlife is a topic of great interest in Pacific Northwest forests because of the implications for riparian zone management. This paper is somewhat unique in measuring abundance, body weight, and breeding condition of small mammals in riparian and upland habitats in the central Oregon Cascades. The author found that numbers of individual animals and species were highest in riparian habitats. Six species were most abundant near streams while two species were most numerous in uplands. Adult weights and numbers of adults in breeding condition were greater in riparian habitats for several species. Juveniles of many species were more abundant in uplands. The author suggests that, for at least four species, riparian habitats act as high quality source areas and uplands as low quality dispersal sinks.

EFFECTS ON CARBON STORAGE OF CONVERSION OF OLD-GROWTH FORESTS TO YOUNG FORESTS by M.E. Harmon, W.K. Ferrell, and J.F. Franklin. 1990. Science 247:699-702. It has recently been suggested that the CO^2 content in the atmosphere could be reduced if slowly growing, old-growth forests were converted to faster growing, forest plantations. This paper reports, however, that the large amount of carbon stored in old-growth forest offsets that higher rate of carbon fixation in young forests. A simulation model showed that even when carbon storage in wooden buildings is tallied, timber harvest results in a net flux of CO^2 to the atmosphere. The authors claim that conversion of old growth to young plantations over the last 100 years in western Oregon and Washington has been a significant source of carbon to the atmosphere.

Mention of trade names or commercial products does not constitute endorsement, nor is any discrimination intended, by Oregon State University.

COPE

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COPE Report

Coastal Oregon Productivity Enhancement Program

Promoting Integrated Management of Oregon's Coast Range Forests
Through Research and Education

Volume 4, Number 1 Winter 1991

The COPE Program

The Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between Oregon State University's (OSU) College of Forestry, the USDA Forest Service Pacific Northwest Research Station (PNW), the USDI Bureau of Land Management (BLM), other federal and state agencies, forest industry, county governments, and the Oregon Small Woodland Association. The intent of the program is to provide resource managers and the public with information relative to the issues and opportunities associated with the management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. The COPE Program emphasizes an integrated approach—an integration of research and education and an integration of scientific disciplines—to find effective ways to manage these diverse resources collectively.

The COPE Program has two related components: Fundamental COPE and Adaptive COPE. Comprised of OSU and PNW scientists based primarily in Corvallis, Fundamental COPE addresses problems related to riparian zone management and reforestation in the Coast Range through basic research. Adaptive COPE is comprised of an interdisciplinary team responsible for applying and adapting new and existing research information to solve specific management problems. Stationed on the coast in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for providing continuing education opportunities to facilitate technology transfer.

Published quarterly, the *COPE Report* provides a means to rapidly disseminate research findings, announce upcoming educational opportunities, and highlight recent publications and topics of interest. Its goal is to foster good resource management by helping people involved in the management of Oregon Coast Range resources to stay well-informed. Comments and suggestions concerning the content of the *COPE Report* are welcomed and encouraged. To receive this free newsletter, contact COPE, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365. Phone: (503) 867-0220.

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ADAPTIVE COPE

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For specifics on the overall COPE Program, contact Steve Hobbs, COPE Program Manager, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331, (503) 750-7426; or Gabriel Tucker, Adaptive COPE Coordinator, 2030 S. Marine Science Dr., Newport, OR 97365, (503) 867-0220.

ADAPTIVE COPE

NEW NAMES AND FACES AT ADAPTIVE COPE

For Adaptive COPE, 1990 was a year marked by great change. The extent of that change is, perhaps, best illustrated by the number of new names on the *COPE Report* masthead and new faces around our offices at the Marine Science Center. Some of these changes have been reported in previous issues of the *COPE Report*. In addition to these changes, Jeff Peterson and Tom McMahon have also moved on to new surroundings. Jeff Peterson left Adaptive COPE in June of last year to work for NSI Technology Services, a contractor for the EPA, in Corvallis, OR. Jeff had most recently filled the position of Wildlife Research Assistant. Tom McMahon resigned in October of last year to take a position as Assistant Professor with the Department of Biology at Montana State University in Bozeman, Montana. Tom was the very first member of Adaptive COPE to be hired. He went to work October 1, 1987 as the Fish Habitat Specialist and was later named the coordinator of the Adaptive COPE team. We wish both Tom and Jeff continued success in their new endeavors.

As the new names on the masthead attest, we have generally been successful filling the vacated positions. The newest member of the Adaptive COPE team is Dr. Gabriel Tucker. Gabe took up residence in Newport in January and fills the position of Silviculturist on the Adaptive COPE team as well as taking on the responsibilities of the team coordinator. He comes to COPE from Lake Placid, New York where he has been working as a Research Associate at Cornell University's Uihlein Sugar Maple Research and Extension Field Station.

Gabe is no stranger to the Pacific Northwest or Oregon. He received a B.S. in Forest Management from Oregon State University in 1976 and an M.S. from the University of Washington in 1982. In an undergraduate thesis at OSU and during his master's work at UW, he worked on the effects of overstory removal on advanced regeneration of western hemlock and silver fir. Between his bachelor's and master's degrees, Gabe worked as an extension forester for the Peace Corps in the west African nation of Niger. He worked on several projects in Niger involving seedling establishment and soil conservation including a year as a research forester at the Niger National Agricultural Research Institute. Then he worked for a year as a consultant to the World Bank on small-scale forestry before returning to the United States for his master's program. After receiving his master's degree, Gabe went to work for CARE in Cameroon and the Republic of Mali for 2 years as a forestry project manager before starting his doctoral program at Cornell in 1985. Gabe's Ph.D. research, which he completed in early 1990, dealt with the ecophysiology and silviculture of sugar maple in the Adirondack Mountains.

Three research assistants have been hired in the last 6 months to fill both vacated and newly created positions. Pei-Fen Lee, who fills the vacated Wildlife Research Assistant position, was the most recently hired. Pei-Fen has just recently completed a Ph.D. in GIS/Remote Sensing from the University of Michigan where he also obtained a concurrent M.S. in Biometrics. He also earned a B.S. in Zoology in 1981 and a M.S. in Ecology in 1983, both from the National Taiwan University. Steve Garman accepted a new position as a Wildlife Research Assistant last July to work on the Adaptive COPE project modeling forest succession and wildlife habitat. Steve comes to COPE from the University of Massachusetts where he recently completed a Ph.D. in Wildlife Ecology. Finally, Jim Schroeder was hired in August of last year to fill the vacant Soils/Hydrology Research Assistant position. Jim recently completed an M.S. in forest hydrology from the University of Minnesota and earned a B.S. in forest resource management from the University of Montana.

Both Doug Bateman and Eric Horvath are now on permanent 9-month appointments to fill technical support roles. Eric holds a B.S. in Zoology from Oregon State University and has worked for Adaptive COPE in several temporary positions censusing birds, mammals, and amphibians for the wildlife research project. Doug earned a B.S. in Science Education from Oregon State University and has also worked n several temporary positions for Adaptive COPE assisting with fisheries and silviculture research.

When you visit Newport, please feel free to drop by our offices in the Hatfield Marine Science Center and get acquainted with the new (or old) members of the Adaptive COPE staff.

AES

MODELING FOREST AND WILDLIFE HABITAT DYNAMICS UNDER DIFFERENT MANAGEMENT REGIMES

Forest scientists and managers are increasingly interested in identifying the responses of forest resources to different stand- and landscape-level management strategies. Studies focusing on wildlife and timber volume production generally either (1) describe current levels of existing stand and/or landscape configurations, or (2) follow response to experimental treatments. Both approaches are valuable, but each has limitations. The former is limited because some management strategies are new and have not been implemented. The latter is limited by the long time scale of forest dynamics. Experiments continued for as long as 10 years cover only a fraction of a rotation. Consequently, there is increasing interest in supplementing these research approaches with computer simulation. Forest succession models can be designed to simulate the effects of an array of forest management practices over decades or centuries.

We are adapting ZELIG, a model of forest succession, to simulate tree, shrub, and wildlife habitat dynamics in managed forests of western Oregon. This type of model has been used effectively in other regions to project the responses of mixed-age, mixed-species forests to natural disturbances and human activities. The approach is among the best available for modeling stands ranging from single-species, even-aged plantations to long-rotation, uneven-aged forests. Moreover, ZELIG's output can be expressed in terms of timber volume production and in terms that allow the classification of wildlife habitat suitability. So the model can be used to help identify the long-term tradeoffs of various management strategies on these two forest resources.

In this article, we describe ZELIG and the modifications to ZELIG that are necessary to simulate wildlife habitats in western Oregon. The results from some initial demonstration runs are presented as an example of the model's capability. Then the anticipated applications of the model to forest management in the Pacific Northwest are described.

Modeling Approach

Like its parent model FORET, ZELIG simulates forest dynamics by tracking the establishment, annual diameter growth, and mortality of individual trees on model plots. The results from several simulated plots are averaged to represent the dynamics of a forest stand. The basic approach in modeling demographic processes is to begin with a maximum potential behavior (e.g., diameter increment, survival probability) and decrement this potential according to the status of the individual tree in the context of the modeled plot. Typical constraints in the model include available light, soil moisture, soil fertility, and temperature. These models have been applied to temperate, tropical, and boreal forests around the world. For details on the formulation and performance of FORET models, see Shugart (1984).

ZELIG has been modified from FORET to be more "user friendly" and to be more easily adapted to different forest types. The current version of ZELIG is implemented as a transect of model plots which interact relative to shading and seed dispersal. Therefore, in addition to within-stand applications, the model can be used to answer landscape-scale questions involving stand size and edge effects. Similar versions are being developed for the Oregon Coast Range, the Oregon Cascades, coastal British Columbia, southern Appalachian hardwood forests, and northeastern hardwood forests. Thus, comparisons will be possible among different locations in the Pacific Northwest and other biomes.

Some additions to the model are needed to simulate forest management and wildlife habitats. A disturbance subroutine is being developed to modify tree mortality and/or growth rate as a function of timber harvest or natural disturbances. Also we are incorporating shrubs, snags, and fallen trees into the model because these elements are important to wildlife habitat. Finally, we have developed a subroutine to classify each model plot in terms of suitability for each wildlife species included in the model.

This modeling approach does not simulate animal demography directly, but does quantify the abundance of habitats suitable for each species. Ecologists have documented strong associations between wildlife and habitat configurations. These associations are described by various methods. The most quantitative perform a multivariate statistical analysis of the microhabitats suitable for a species. We are developing multivariate classification functions for several wildlife species which distinguish plots where species are found from plots where they are not found. Two-group Discriminant Analysis has been used in previous applications. Logistic regression and Principal Components Analysis are also being evaluated. Field studies currently being carried out by COPE and other groups in the northwest are being used to generate habitat classifications. Higher-level criteria for habitat suitability can be overlaid on to the microhabitat classifications. Such constraints might include minimum area requirements for species with large territories, or distance from forest openings for species that either seek or avoid edge.

A Demonstration

To demonstrate this approach, we performed some initial applications with ZELIG. Appropriate vegetation and bird data were available for a natural forest in the H.J. Andrews Experimental Forest in the central Oregon Cascades. The model was initiated to conditions typical of young patches in the stand (ca. 100 years old). Three forest succession scenarios were then simulated. The first scenario depicted natural succession for 800 years without disturbances. In the second scenario, western hemlock was removed to depict the loss of a dominant tree species due to forest management. Large Douglas-fir (>50cm dbh) were removed in the third scenario to simulate selective harvest.

The run simulating natural succession produced patterns similar to those documented for the H. J. Andrews. Douglas-fir and western hemlock were the prevalent species with western hemlock becoming dominant after several hundred years (Figure 1a). Removing western hemlock from the model resulted in slightly more Douglas-fir and subordinate shade tolerants (Figure 1b). Removal of large Douglas-fir dramatically increased the amount of western hemlock (Figure 1c).

Bird habitat suitability was dynamic. For example, hermit warbler, an open-canopy specialist associated with intermediate-sized Douglas-fir, was most abundant in the baseline run prior to hemlock canopy closure and after gaps opened in the canopy later in succession (Figure 2a). Habitats for this species were also more abundant when hemlock and large Douglas-fir were removed. Habitat for winter wren, a closed-forest specialist associated with intermediate and large hemlock, was greatest when large Douglas-fir were removed and least when hemlock was removed (Figure 2b).

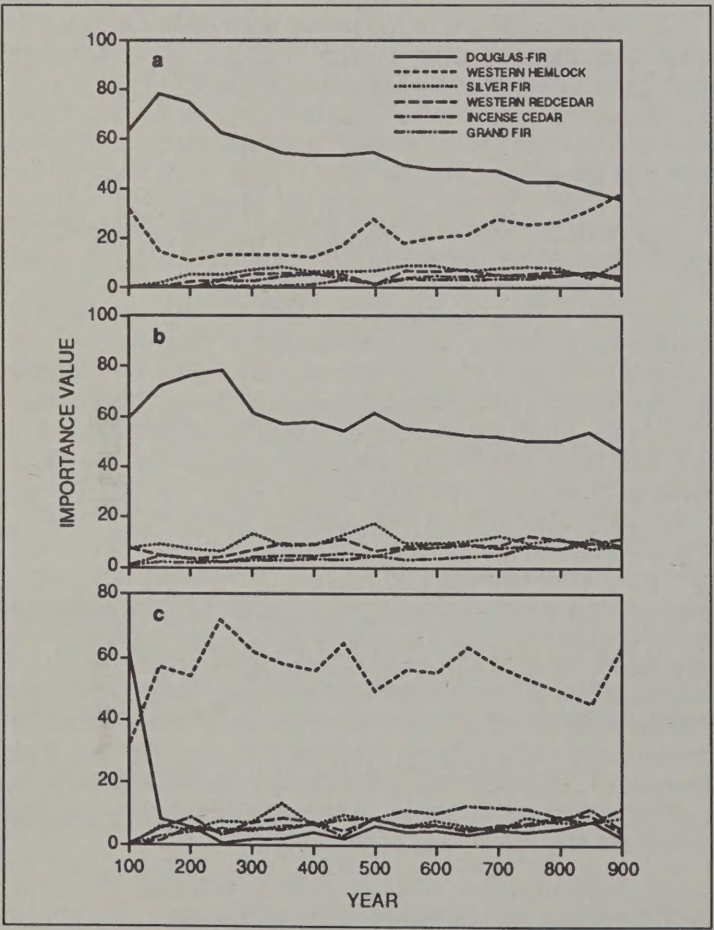

Figure 1. Simulated forest succession with ZELIG initialized for conditions at 1000 m elevation in the H.J. Andrews Experimental Forest in the Oregon Cascades under (a) baseline conditions, (b) western hemlock excluded, and (c) Douglas-fir >50 cm dbh removed. Importance value is a function of basal area and stem density expressed as a percent.

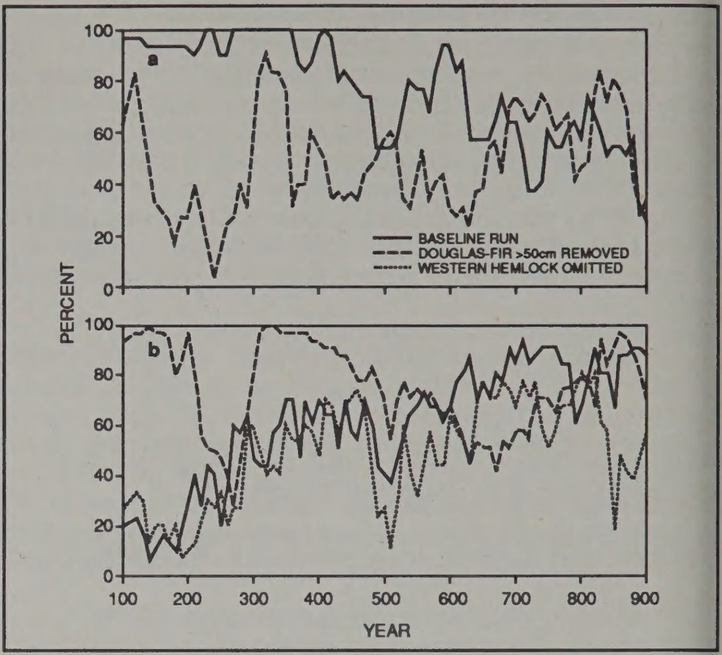

Figure 2. Percent of model plots classified as suitable habitat for (a) hermit warbler and (b) winter wren under the three forest simulations illustrated in Figure 1.

This exercise provides an example of the ability of the model to project forest dynamics and animal habitat abundance under different management regimes. However, performing this exercise revealed nuances in the model and the approach that require attention. Simulations initiated from bare ground did not produce realistic results suggesting that model modification will be needed to simulate young plantations. Also, both the vegetation model and the habitat classification method were sensitive to, respectively, the number of tree species included in the model and the types and spatial scales of variables used to describe habitat. Refinement and testing of the model are needed before the results can be viewed as realistic.

Testing and Application

During the first year of the study, we are adding consideration of shrubs to the model and creating subroutines for disturbance, snags, logs, and habitat classification. We are also assembling data sets on vegetation and wildlife habitat requirements to parameterize and test the model.

The degree to which the vegetation model simulates reality will be determined by comparing model output to independent field data. The model will be adjusted until it properly generates young and old-growth stands at low and high elevations. Model runs will then be made across a range of seral stages and elevations. The habitat classification subroutine will be validated by examining its ability to predict the relative abundance of wildlife species in census plots not used to generate the habitat classification functions.

Application of the model involves predicting long-term habitat suitability and timber volume production of managed stands under a range of silvicultural treatments. The simulations will cover a 500-year period in an experimental design with the treatments being rotation age (40-250 years), age structure (evenaged, unevenaged), and habitat structure (snags, logs, shrubs, and live trees). Forest succession simulated under a natural disturbance regime will serve as the control. This experimental design will be applied at low, intermediate, and high elevations. The model will also allow examination of the effects of landscape-level strategies involving harvest rates, harvest unit size, and edge characteristics. The results of modeling these alternative management strategies will help quantify timber volume production and wildlife habitat trade-offs.

Recommended Readings

Shugart, H.H. 1984. A theory of forest dynamics. Springer-Verlag, New York.

Smith, T.M. and D.L. Urban. 1988. Scale and resolution of forest structural pattern. Vegetatio 74:143-150.

Urban, D.L. and T.M. Smith. 1989. Microhabitat pattern and the structure of forest bird communities. American Naturalist 133:811-829.

Andy Hansen and Steve Garman,
Adaptive COPE and OSU,
Dean Urban,
University of Virginia

VOLUNTEER RAINGAUGE NETWORK UPDATE

During the summer of 1989, Adaptive COPE took over the administration of a volunteer raingauge network covering the central Oregon coast. The network had previously been administered by the Siuslaw National Forest and the State Climatologist's office. The primary objective of the raingauge network is to take advantage of existing rainfall measuring capacity and augment rainfall data from other sources. There are two such sources along the Oregon Coast, the Oregon "Cooperative" network and the Fundamental COPE precipitation-intensity raingauge network administered by Dr. Henry Froehlich of the Forest Engineering Department, Oregon State University (see article this issue). Administering the volunteer raingauge network enables us to continue to take advantage of this unique data source. Researchers need rainfall data from all sources to put COPE research into the proper hydrologic perspective.

When COPE assumed administration of the volunteer raingauge network, two steps were taken to get as many volunteers involved as possible. First, all members of the original volunteer network were asked whether they wanted to continue providing rainfall data and, secondly, new raingauge network volunteers were sought through the *COPE Report* and other sources. As a result of these efforts, 20 people agreed to participate in the volunteer raingauge network. The name of the contact person for each raingauge and the key name identifying their raingauge location are listed in Table 1. These raingauge locations range from Pacific City to Reedsport and over to the foothills west of Eugene.

To date, the network volunteers have had to respond favorably to our inquiry regarding continued rainfall data collection and, then, send in some data. Some volunteers have been more than generous. Gladys and Stuart Myers from Blachly and Michael Atkinson from Coyote, for example, sent in data sets spanning over 20 years. All the data have been recorded in a computer database and a summary of rainfall for the 1990 calendar year has been generated. We apologize for presenting rainfall data on a calendar year basis. An attempt was made to summarize rainfall for the 1990 water year but the data was insufficient for the last quarter of 1989. Calendar year data will have to suffice, and as the quality and quantity of data improves, water year summaries will be presented.

Table 2 summarizes both monthly and total annual rainfall data for the 1990 calendar year. The table includes the nine most complete data sets. Total annual rainfall ranged from 42.35 inches to more than 88.67 inches. The maximum monthly rainfall was 21.48 inches. Even though the data set is not very extensive and not quite complete, it is easy to see the variability of rainfall for the Oregon Coast Range.

We are still interested in expanding the volunteer raingauge network. If you or your office has the capacity or are currently keeping a record of daily rainfall and would like to share that information, then please contact the Adaptive COPE office. We will make every effort to make your participation as easy as possible. We will supply monthly rainfall forms and self-addressed, stamped envelopes. All you have to do is fill out the forms and mail them in. In return, you will receive periodic

Table 1. A list of COPE volunteer raingauge network participants and their station identifiers.

Participant	Station Identifier
Linda & Jamie Montanez	Alsea
Gladys & Stuart Myers	Blachly
Nick Jansen	Burnt Mtn.
Michael Atkinson	Coyote
Paul Dane	Five Rivers
Ken Lukens	Gleneden
Kent Stevenson	Gopher
Bernice Plawman	Hebo
Barbara Mock	Kellogg
Mike Shelby	Lincoln City
Ron Gray	McIntosh
Duane Honsowetz	Otis 1
Ray Touchstone	Otis 2
Jean Gogas	Pacific City
John Goold	Reedsport
Nick Jansen	Signal Tree
Ronny Shelton	Sutton
Tom Smith	Ten Mile
Angela Rosin	Toledo
Gary Beacher	Vaughn

Table 2. Annual and monthly rainfall (in.) for the 1990 calendar year for selected members of the COPE volunteer raingauge network.

	Coyte	Five R	Gopher	Kllgg	McIntsh	Otis	Rdsprt	Sttn	Tnml
Jan	10.54	-	21.48	10.38	13.47	20.00	-	14.90	20.28
Feb	5.75	-	14.62	6.96	10.20	16.08	-	11.04	13.49
Mar	2.58	-	5.76	2.34	5.25	5.98	-	5.35	6.68
Apr	2.32	5.46	8.60	2.21	4.59	7.69	5.00	9.22	8.86
May	2.70	5.31	-	3.13	3.90	6.20	3.92	5.04	4.50
June	2.05	2.18	3.29	0.75	3.54	-	3.64	3.46	5.80
July	0.59	0.48	0.50	0.29	0.36	-	0.21	0.59	0.95
Aug	1.70	-	1.06	1.61	1.26	-	1.24	1.35	-
Sept	0.37	1.76	1.13	0.04	0.16	0.28	0.10	0.19	1.60
Oct	5.86	8.88	9.69	5.22	11.05	8.82	11.83	10.09	9.26
Nov	6.21	11.95	14.12	5.67	-	14.03	11.65	12.05	11.74
Dec	4.00	6.57	7.98	3.75	4.53	8.19	4.93	5.72	5.51
1990	44.67	42.59+	88.23+	42.35	58.31+	87.27+	42.52+	79.00	88.67+

summaries of the accumulated data and our most heartfelt gratitude. If you are interested, please call or write Arne Skaugset at the Adaptive COPE offices in Newport.

Arne Skaugset and Jim Schroeder
Adaptive COPE

FUNDAMENTAL COPE

MODELING COMPETITION-EFFECTS IN YOUNG STANDS: AN UPDATE

Modeling the effects of competing vegetation on the growth and yield of young Douglas-fir has been a cooperative effort of COPE and CRAFTS (Coordinated Research on Alternative Forestry Treatments and Systems) since 1987. The *COPE Report* article by Opalach and Radosevich (*COPE Report* 1(3):2-4) provided the first newsletter presentation of the modeling work. The final year of financial support to the CRAFTS' modeling effort by COPE was 1990. It is appropriate, then, to provide an update on the status of the modeling effort with a view of the future.

Three key items characterize the modeling effort since the summer of 1988. *First*, the conceptual model, ICIPS, has been displaced by the prototype model, **df et al.** This prototype model incorporates the methodology from ICIPS into an updated, reformatted computer model with height and percent cover equations parameterized to data from the CRAFTS Coast Range Competition Release Study. *Secondly*, a major change in personnel has occurred with the departure of Dan Opalach, the previous Project Leader, and the arrival of Bob Shula and Steve Knowe, new Principal Investigators. Bob Shula, a doctoral candidate with Dave Hann at OSU and previously with the New Zealand Forest Research Institute, is primarily responsible for the CRAFTS modeling effort, Steve Knowe, who most recently received a Ph.D. from the University of Georgia, is primarily responsible for a CRAFTS'/USFS contract for a Regional Vegetation Management Model. *Finally*, CRAFTS' previous collaboration with COPE has been replaced with a 5-year contract with the Forest Service. The contract is for the development of a Regional Vegetation Management Model for estimating young stand growth and yield, inclusive of vegetation competition effects and prescribed vegetation treatment options. The contract gives consideration to the spirit of the 1989-90 mediated agreement involving the Forest Service and public regarding the use of herbicides.

df et al. predicts height and cover development to age 10 with extrapolation to age 20 of young, Coast Range Douglas-fir stands that contain any combination of red alder, vine maple, salmonberry, and thimbleberry. The model consists of a series of differential equations relating to temporal change in species' state variables. For Douglas-fir, the state variables include dominant height, crown width, crown length, and trees per acre. For red alder and each shrub species, the state variables include dominant height and percent cover. Each species' state variables are associated with rate variables which define growth or temporal change in state variables. In addition to state and rate variables, the model has auxiliary variables which quantify and incorporate the effects of intra- and interspecific competition. In the absence of competition state variables of a species are assumed to follow a potential or maximum growth trajectory. The potential height growth of Douglas-fir and red alder is defined by height growth and site index equations by Means and Sabin (1989), and Harrington and Curtis (1986), respectively. **df et al.**'s prediction of height for these species pertains only to dominant trees and stand-level or tree-list predictions cannot be generated.

The following simulation results are based on 300, 1.5-foot-tall dominant Douglas-fir trees per acre at year 1, no mortality from age 1 to 20 years, and a Douglas-fir site index of 125 feet. In the absence of salmonberry, dominant Douglas-fir attain a height of 49.4 feet at 20 years (Figure 1a) and crown closure occurs at 13 (Figure 1b). If salmonberry dominates the site (2 feet in height and 50 percent cover at year 1), dominant Douglas-fir reach a height of 42.6 feet at 20 years (Figure 2a) and crown closure occurs at 16 (Figure 2b). Note the rapid decline in salmonberry as Douglas-fir assumes dominance of the hypothetical site (Figure 2b).

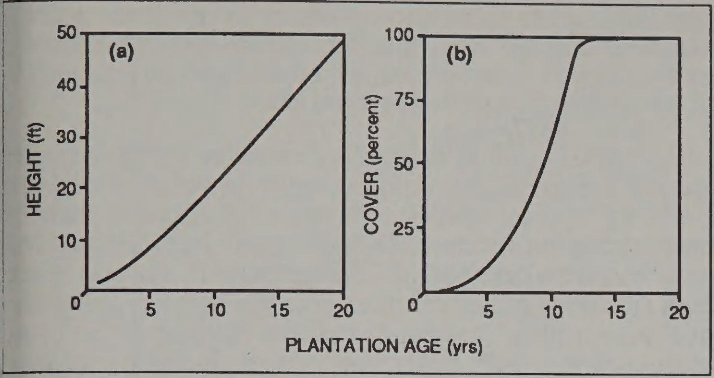

Figure 1. The height (a) and cover (b) development of Douglas-fir in the absence of salmonberry.

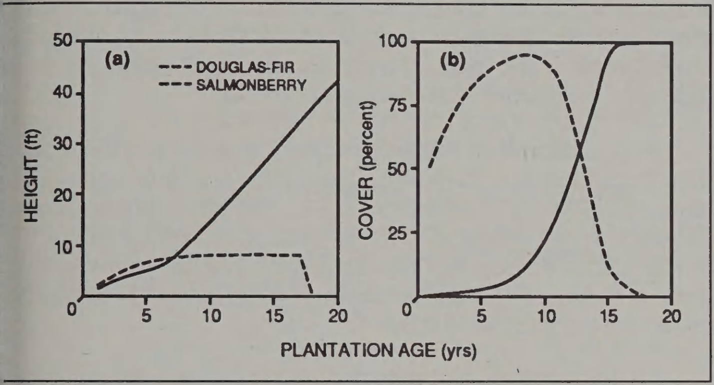

Figure 2. The height (a) and cover (b) development of Douglas-fir and salmonberry.

Conspicuous deficiencies in **df et al.** illustrate needed improvements in the model. These improvements are described in a Program of Work and are summarized here. The first needed improvement is the ability to predict stand-level and tree attributes such as tree height, stem diameter, mortality, and crown characteristics. Second, dataset representation and equation parameterization are needed across the geographic domain of the project including the Coast Ranges of Oregon, Washington, and British Columbia, the western Cascades, and the Siskiyous of southwestern Oregon. Third, compatibility is needed with prevailing growth models so that output from the CRAFTS model stand-level and tree attributes will have a suitable format, be smooth and continuous, and represent acceptable input to the prevailing models. Fourth, the model needs the ability to predict the growth and yield of some hardwoods, particularly red alder and bigleaf maple. Finally, the model needs the ability to interface with the treatment-effects model VEGPRO (Wagner et al. 1990).

The project's Program of Work describes a critical path for achieving these improvements and developments. Current project work is reviewing the previous modeling effort. This review and assessment are scrutinizing how grand the model can be, given the available database. The modeling project has seven goals for 1991: (1) formalized project review and evaluation, (2) expansion of the database for short-term modeling using common denominator variables to accommodate either stand-level or tree models, (3) investigation of alternative forms of models, (4) recovery of diameter distribution from the available database, (5) investigation of an alternative measure of site productivity for young stands, (6) development of a database for long-term growth and yield modeling for Douglas-fir and some hardwoods, and (7) enhancement of VEGPRO regarding non-chemical vegetation management treatments.

The key to the ultimate success of this project is the collaboration with other research groups. Collaboration will be pursued in modeling methodology and data-sharing, and is expected to include the Stand Management Cooperative at the University of Washington, and the Hardwood Silviculture Cooperative at Oregon State University.

The ultimate goal of the project is to produce a competition-effects growth and yield model for young stands that provides reliable predictions founded on a broad database representative of the expectation of young stand forest management. Modeling is not an end in itself, but rather a means by which the scenarios of the future can be played out to advantage.

For further information, or to offer comment contact us at (503) 737-2244.

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VEGETATION PATTERNS IN RIPARIAN FORESTS

For all the attention that riparian ecosystems have received in the last decade, it is surprising how little published information is available concerning the composition, structure, and dynamics of riparian vegetation. On the other hand, the lack of published field studies is perhaps one of the reasons for debate in professional and public arenas.

Although there have been at least four studies of the ecology of red alder forests in the Coast Range (Franklin and Pechanic 1968; Newton et al. 1968; Henderson 1970; Carlton 1989), we are unaware of any literature that focuses directly on any of the following questions. What are the major plant assemblages associated with riparian ecosystems? How do plant communities change from the stream edge to the uplands and what factors are associated with those changes? How does landform and geomorphology influence plant community composition and productivity? What are the rates of tree mortality and woody debris inputs to streams in riparian forests?

Answers to these and other questions are being pursued in several studies on the ecology of riparian zone vegetation. The results of these studies will provide COPE scientists with a more complete ecological context for fish, wildlife, and silvicultural studies and will provide land managers with an ecological framework for planning and management.

In this article we report on three studies recently initiated in the central Coast Range of Oregon whose general objective is to improve the understanding of the structure and dynamics of unmanaged riparian forest ecosystems. We focus initially on unmanaged systems to develop a reference point for management and to obtain a better picture of the ecosystem conditions to which many plants and animals have been accustomed or adapted.

Study 1

The major focus of our efforts for the past 2 years has been to characterize plant community composition and structure on geomorphic features adjacent to and upslope from streams. As a source of small and large organic debris, streamside vegetation is a major determinant of habitat quality for aquatic and terrestrial organisms. It may control the habitat structure of terrestrial vertebrates that use the riparian zone. While the importance of streamside vegetation is widely recognized, relatively little information is available on how plant communities change along stream corridors and how they change from the stream edge into the uplands. In addition, riparian ecosystems appear to be more dynamic relative to the uplands and consist of a complex mosaic of vegetation, soils, physiography, microclimate, and disturbance. Knowledge of the characteristics of plant communities and their relationships to the riparian environment will help define management alternatives for riparian zones.

This study has three goals: (1) to characterize plant species groups or assemblages of riparian vegetation, (2) to determine how patterns in the vegetation are related to geomorphology, canopy cover, and other environmental variables, and (3) to define the riparian zone from a plant community perspective.

We collected data at 93 different sites along 42 streams of varying order in the central Coast Range in 1989 and 1990. The sites were distributed on an east to west gradient from Mary's Peak to the coast to sample a range of climatic conditions. Site selection was stratified on the basis of stream order, valley width, and overstory type and age. Sampling was concentrated in Drift and Lobster Creek basins, primarily in unmanaged ecosystems. Some managed stands representing younger age classes were also sampled. Data on herb, shrub, and canopy cover, basal area, tree regeneration, woody debris, snags, geomorphology, soils, and stream characteristics were collected along transects oriented perpendicular to the stream. Transects extended from the stream edge, across the valley floor, and to at least 25 meters above the slope break.

Preliminary analysis of data from the 1989 field season show that geomorphic features (Figure 1), valley width, and overstory type (hardwood, conifer, shrub) are important in determining the structure of riparian plant communities. Salmonberry is the dominant species in riparian areas and affects both the development of herbaceous plant communities and tree regeneration. The results indicate that vegetation of the valley floor is usually distinct from vegetation of the adjacent valley walls. Within the valley floor, gravel bars, flood plains within the active channel surface, seeps, back channels, and terraces frequently had distinctive plant assemblages. Within terraces, which are often the largest feature of the valley floor, we found little change in vegetation from the streamside to the slope break. The slope break serves as a transition from "riparian" vegetation to upslope vegetation.

Species diversity was slightly greater on the valley floor than on the valley wall (Figure 2), and was greater on wide valley floors than narrow ones. The apparent landform-vegetation relationships raise interesting questions about the mechanisms driving the relationships. We are investigating some of these potential mechanisms, such as disturbance and soil moisture, in other studies.

Regeneration of overstory tree species was quite limited at the sites we studied (apparently supporting the findings of Minore and Weatherly, in preparation). The presence of large woody debris proved critical for successful regeneration and survival of conifers. Large wood not only provides a suitable seedbed for shade tolerant conifers but a "gap" in the shrub canopy. Young hardwoods, primarily red alder, were able to establish and survive on freshly disturbed mineral soil.

Preliminary results indicate that valley floors have a lower stocking of conifer snags than adjacent valley walls (Figure 3). This suggests that many wide valley floor areas currently are relatively poor sources of large woody debris for streams and may provide lower quality habitat for cavity nesting species.

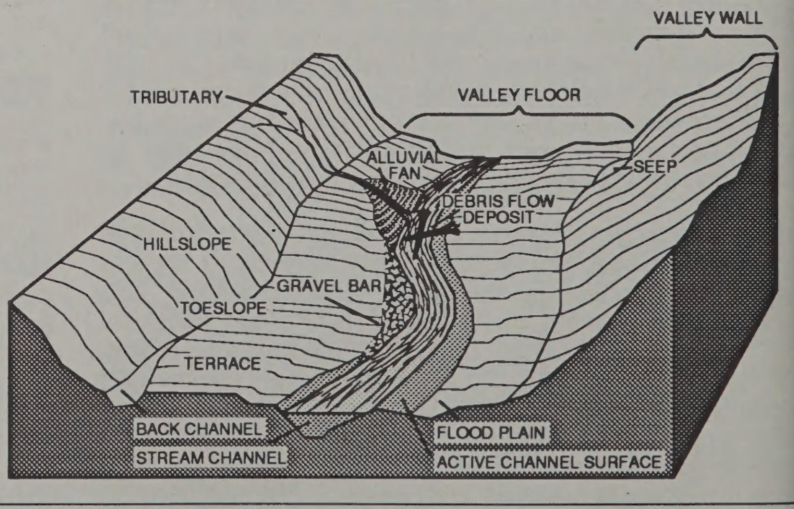

Figure 1. Geomorphic surfaces and other features of the riparian zone.

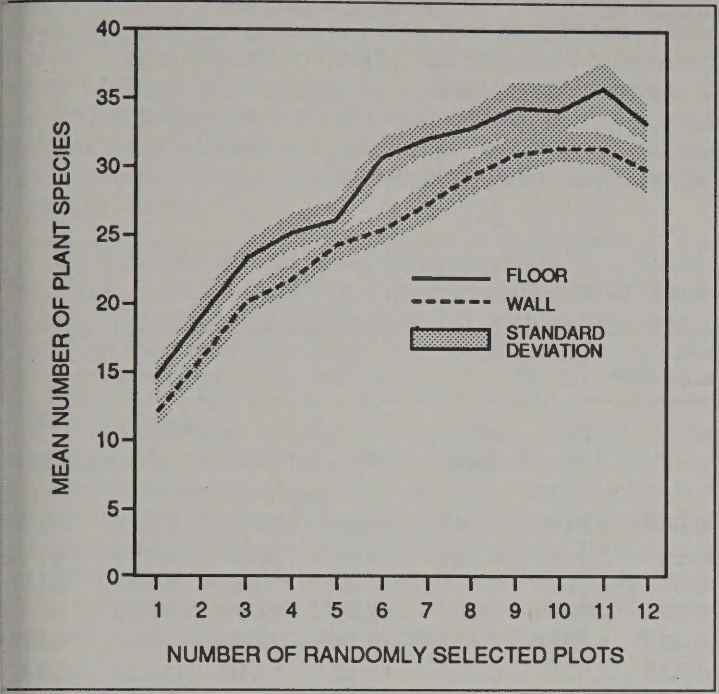

Figure 2. Plant species diversity on the valley floor and valley wall (means and standard errors).

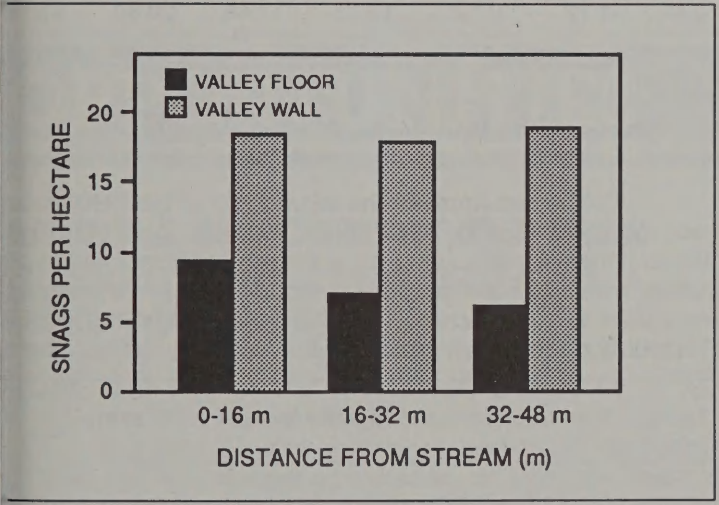

Figure 3. Conifer snag density by distance from stream on the valley floor and valley wall.

This winter, data from 1989 and 1990 will be combined and analyzed, with manuscript preparation to follow. During the coming field season we will expand the plant community research to the Elk River basin in southwest Oregon.

Study 2

How did mature conifer and hardwood riparian forest stands of the Coast Range reach their current stage of development and how will they develop in the future? To help answer these questions, we established two large "reference stands" in which all live and dead trees are mapped and will be followed through time. While this is a long-term study of forest structure and dynamics, it will provide some short-term information about how riparian stands developed, how overstory patterns influence understory development, and how productivity varies across a riparian zone. This study has six specific objectives:

- To conduct a detailed analysis of the age structure and development of conifer and hardwood dominated riparian stands,
- To track growth and mortality rates and regeneration of tree species,
- To monitor large woody debris production and input rates to the stream,
- To evaluate predictive models on woody debris input to the stream (Van Sickle and Gregory 1990),
- To study the dynamics of the shrub-dominated understory, and
- To characterize the ground water regime relative to geomorphology.

The reference stands are located along two second-order streams: upper Flynn Creek, in the Flynn Creek Research Natural Area, and along upper Trout Creek, north of the Drift Creek Wilderness. The Flynn Creek stand borders a meandering, unconstrained stream reach with a moderately wide valley floor. The stand has a high proportion of red alder. The Trout Creek stand is along a constrained stream reach with little or no valley floor development. It is a conifer-dominated stand that exhibits old-growth characteristics like multiple canopy levels, large snags, and large woody debris.

Both stands are about 2 hectares in size: 200 meters in the direction parallel to the stream and 100 meters perpendicular, with the stream approximately bisecting the area. Within these stands, each tree over 5 cm dbh is mapped and tagged. Locations of snags and the distribution of large woody debris are mapped as well. Data will be collected for the duration of the COPE Program and beyond.

Study 3

In the third study we are monitoring plant community development, including tree and shrub regeneration, following natural disturbance in the riparian zone. During the spring of 1990 we established vegetation sampling plots at four sites that were recently (within 1 1/2 years) subject to various scales and intensities of disturbance. Three of these sites experienced small-scale disturbance like windthrow and sheet erosion, while the fourth is on a large debris flow. In this study we will evaluate how natural disturbances of different types affect successional pathways of riparian zone vegetation. The information will be valuable for determining the stability of vegetative assemblages in riparian areas. Data collection and the addition of more sites will continue for the duration of COPE.

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SUMMARY OF PRECIPITATION DATA FOR APRIL - NOVEMBER 1990

There was 70 percent more rainfall during the spring of 1990 and 25 percent less during the summer than during the previous year in the central Oregon Coast Range. This information comes from data collected as a part of a Fundamental COPE research project under the direction of Dr. Henry Froehlich, Department of Forest Engineering, Oregon State University. A network of raingauges was installed in 1988 (*COPE Report* 2(1):6) to determine rainfall amounts, patterns, and intensities to help explain landslide behavior within the central Coast Range (*COPE Report* 1(1):6-8). Rainfall amounts for the 1989 water year were reported in *COPE Reports* 2(3):6-7 and 3(1):8.

Within the raingauge network, the rainfall for the second half of the 1990 water year (April 1 - September 30) ranged from 14 to 27 inches and the rainfall for the entire water year ranged from 60 to 110 inches which represents an average of 79 inches for the central Coast Range. This is a decrease of approximately 10 percent from the 1989 water year. Monthly rainfall amounts are summarized in Table 1. The locations of the raingauges are described in the *COPE Report* articles referenced above.

Table 1. Monthly rainfall for April - November 1990.

	Precipitation (inches)									
Gauge	Apr	May	June	July	Aug	Sept	Oct	Nov	Apr-Sep 1990	Wy 1990
1	9.12	5.92	3.76	0.56[e]	2.93[m]	0.34[m]	18.36	11.40	22.63	110.75
2	10.20	4.68	2.96	0.56	2.44[e]	0.29[m]	14.32	10.48	21.13	84.69
3	9.24	4.52	4.00	0.48	2.00	0.28	nd	nd	20.52	83.56
4	12.88	4.88	5.00	0.76	2.92	0.36	17.00	13.36	26.80	98.68
5	6.64	4.04	2.86[m]	0.42[m]	1.62[e]	0.23[m]	12.16	9.52	15.81	62.73
6	7.76	3.88	3.64	0.52[e]	2.32[m]	0.27[m]	13.12	11.16	18.39	70.87
7	6.48	4.68	3.44	0.52	2.52	0.04	11.96[e]	10.44	17.68	63.88
8	6.13[m]	4.00	2.28	0.36	2.16	0.12	9.40	7.40	15.05	59.22
9	5.48	3.48	2.36	0.36	2.20	0.14	9.92	8.52	14.02	59.90
11	6.80	5.08	3.20	0.44	2.68	0.76	16.00	9.68	18.69	89.32
12	10.52	4.16	3.84	0.44	1.72	0.12	13.76	11.68	20.80	81.16

nd no data available at time of report.

[e] portion of record estimated from nearby gages.

[m] missing data; monthly precipitation estimated by ratio method.

The largest storm for the second half of the 1990 water year occurred during April 26-27. Within the raingauge network, total rainfall during the storm ranged from 2.44 to 6.36 inches with recorded maximum hourly intensities ranging from 0.24 to 0.52 inches (Table 2). Based on the NOAA Precipitation-Frequency Atlas of the Western United States

Table 2. Rainfall amount and intensity for April 26-27 storm.

	Precipitation (inches)			Total
Gauge	1 hour	2 hour	24 hour	Storm
1	0.40	1.96	4.68	4.76
2	0.48	2.44	5.64	5.68
3	0.44	2.24	5.36	5.36
4	0.52	2.72	6.32	6.36
5	0.32	1.32	2.96	2.96
6	0.36	1.88	4.40	4.44
7	0.40	1.80	3.28	3.36
8	na	na	na	2.65[e]
9	0.24	1.16	2.44	2.44
11	0.28	1.52	3.44	3.56
12	0.48	2.56	6.12	6.12

na data not available due to gauge malfunction.

[e] estimated from nearby gauges.

(Vol. X - Oregon), the return interval for this storm is approximately 2 years.

From July 6 to August 16, and August 30 to October 1, there was negligible rainfall. The lack of rainfall caused drought stress in seedlings and young trees on exposed slopes and increased the fire hazard from low to moderate during late July and August.

The first 2 months of the 1991 water year, October and November, had above-average rainfall ranging from 17 to 30 inches. The two storms at Thanksgiving produced between 5 and 9 inches of total rainfall with peak hourly intensities ranging between 0.3 and 0.5 inches.

Three more raingauges have been installed by the Forest Service on the Alsea District of the Siuslaw National Forest. Two of the raingauges are located in the southern part of the district in the Five Rivers-Lobster Valley drainage. The third raingauge is located in the northern part of the district in the Deer Creek watershed of Alsea Watershed Study fame. Data from these raingauges will be included in the next summary in the summer issue of the *COPE Report*.

Kevin Lautz
OSU Forest Engineering Department

OPPORTUNITIES

LANDSLIDES/FORESTRY/FISHERIES INTERACTIONS IN SW OREGON: A FIELD TOUR

June 10-12, 1991 Gold Beach, OR

This field tour was originally scheduled for October 1-3, 1990 but was postponed because, at that time, federal budget constraints ruled out participation in the field tour by federal employees. The new date for the field tour allows federal employees the opportunity to participate fully. The objectives remain to present technical information about the geology, geomorphology, aquatic habitat, and fisheries of Southwest Oregon and to discuss the recognition and management of unstable landforms in Southwest Oregon with emphasis on landslide prevention and fish habitat protection.

The intended audience for the field tour is field-level resource professionals interested in the geology, geomorphology, and fisheries interactions specific to Southwest Oregon. "Field-level" resource professionals are individuals who spend a majority of their time in the field making management decisions, on virtually a daily basis, that have the potential to affect slope stability. The field tour is designed for these individuals who have no formal training in slope stability. It will deal specifically with the geology, geomorphology, and fisheries of Southwest Oregon.

A brochure should be available at this time. Because this will be a field tour, attendance will be limited; therefore, early enrollment is encouraged. For information regarding the content of the field tour, contact Arne Skaugset at the Adaptive COPE offices in Newport. For registration information, contact the Conference Assistant, College of Forestry, OSU, 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

SOIL BIODIVERSITY AND FUNCTION

April 2-6, 1991 Corvallis, OR

The purpose of this symposium is to improve the understanding of soil ecology at all levels of resolution, from micro to global scales, and to assess the impact of soil ecology on global climate change.

For more information on this symposium, contact the Conference Assistant, College of Forestry, OSU, 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

MONITORING NATURAL RESOURCES

May 6-8, 1991 Corvallis, OR

The purpose of this symposium is to develop a fundamental understanding of monitoring programs for natural resources. It is intended for practitioners in natural resources monitoring.

The symposium has several areas of emphasis: design, implementation, information management, data analysis, program evaluation, reporting results, and future frontiers. Enrollment is limited for this symposium, so early registration is encouraged.

For more information on this symposium, contact the Conference Assistant, College of Forestry, OSU, 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

RECENT PUBLICATIONS

LOGGING EFFECTS ON STREAMFLOW: STORM RUNOFF AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA by K.A. Wright, K.H. Sendek, R.M. Rice, and R.B. Thomas. 1990. Water Resour. Res. 26(7):1657-1667. A paired-watershed study was conducted in northwestern California to assess the hydrologic effects of road building and timber harvesting. Changes in flow volumes, peak flows, and hydrograph lag times were examined for a watershed in which 67 percent of the timber volume was harvested and 5 percent of the area was occupied by roads. Flow volumes and peak flows were increased only for small storms (peak flows less than 566 L/s). Although 15 percent of the watershed was compacted, flows for large events were not increased. Logging generally decreased lag times, but the shapes of the hydrographs were unchanged. Past studies by others have indicated that peak flows increase due to road building and soil compaction above certain levels. The authors attribute the different findings to the sensitivity of regression analyses to data distribution, citing a lack of high flow data in previous studies as responsible for "observed" increases in large peak flows.

JS

LOGGING EFFECTS ON STREAMFLOW: WATER YIELD AND SUMMER LOW FLOWS AT CASPAR CREEK IN NORTHWESTERN CALIFORNIA by E.T. Keppeler and R.R. Ziemer. 1990. Water Resour. Res. 26(7):1669-1679. The effects of selectively logging second-growth Douglas-fir and redwood on low flows and annual yield were studied for the coastal region of northern California. A paired-watershed experiment was conducted; the treated watershed had 5 percent of the area occupied by roads and 67 percent of the timber volume harvested. Statistically significant enhancement of water yield by selectively harvesting second-growth timber is possible. However, the authors cite several complicating factors: (1) 90 percent of the flow increase occurred during high-flow rather than peak-demand periods, (2) 5 years after logging, significant increases in flow were no longer detected, (3) increases in flow were highly variable during the first 5 years following harvest, and (4) the negative side effects of road building and logging, such as increased sediment yield, may offset the benefits of increased flow.

JS

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COPE Report

Coastal Oregon Productivity Enhancement Program

Promoting Integrated Management of Oregon's Coast Range Forests
Through Research and Education

Volume 4, Number 2 Spring 1991

The COPE Program

The Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between Oregon State University's (OSU) College of Forestry, the USDA Forest Service Pacific Northwest Research Station (PNW), the USDI Bureau of Land Management (BLM), other federal and state agencies, forest industry, county governments, and the Oregon Small Woodland Association. The intent of the program is to provide resource managers and the public with information relative to the issues and opportunities associated with the management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. The COPE Program emphasizes an integrated approach—an integration of research and education and an integration of scientific disciplines—to find effective ways to manage these diverse resources collectively.

The COPE Program has two related components: Fundamental COPE and Adaptive COPE. Comprised of OSU and PNW scientists based primarily in Corvallis, Fundamental COPE addresses problems related to riparian zone management and reforestation in the Coast Range through basic research. Adaptive COPE is comprised of an interdisciplinary team responsible for applying and adapting new and existing research information to solve specific management problems. Stationed on the coast in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for providing continuing education opportunities to facilitate technology transfer.

Published quarterly, the COPE Report provides a means to rapidly disseminate research findings, announce upcoming educational opportunities, and highlight recent publications and topics of interest. Its goal is to foster good resource management by helping people involved in the management of Oregon Coast Range resources to stay well-informed. Comments and suggestions concerning the content of the COPE Report are welcomed and encouraged. To receive this free newsletter, contact COPE, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365. Phone: (503) 867-0220.

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ADAPTIVE COPE

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Typing: Marcy Berg

Because of space limitations, articles appear as extended abstracts. Results and conclusions may be based on preliminary data and/or analysis. Readers interested in learning more about a study should contact the principal investigator or wait for formal publication of more complete results. For specifics on the overall COPE Program, contact Steve Hobbs, COPE Program Manager, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331, (503) 750-7426; or Gabriel Tucker, Adaptive COPE Coordinator, 2030 S. Marine Science Dr., Newport, OR 97365, (503) 867-0220.

The Winter 1991 issue of the COPE Report was erroneously published as Volume 3, Number 4. Please note that the Winter 1991 issue of the COPE Report is Volume 4 Number 1.

ADAPTIVE COPE

UNDERPLANTING CONIFERS IN RIPARIAN FORESTS: FIRST-YEAR RESULTS

A focus of Adaptive COPE is integrating research results among disciplines. The importance of this integration is best illustrated by the role of large woody debris (LWD), especially conifers, in streams. A considerable portion of the riparian forests throughout the Oregon Coast Range have been disturbed by fire or harvesting and have reestablished to a red alder overstory with a shrub understory. Red alder cannot duplicate conifers in stream processes and conifers are not likely to reestablish naturally under red alder and shrubs. Therefore, Adaptive COPE is studying ways to actively manage riparian forests to reestablish conifers. Active management of riparian zones to promote conifer establishment will benefit fisheries and provide timber, wildlife habitat, and other benefits.

Methods

An investigation of the survival and growth of conifer seedlings planted in alder and shrub dominated riparian forests was initiated in the summer of 1989 at six sites from Astoria to Gold Beach (COPE Report 2(3):4-5). Both overstory alder and understory shrubs were treated at each site. For the overstory treatments the alder was: (1) "totally" killed, (2) "partially" killed leaving approximately 1/3 of the overstory widely spaced, or (3) not treated (control). For the understory treatment the shrubs were killed on half of each overstory plot, or not treated (control). On three of the study sites the overstory was girdled and on the remaining three study sites the overstory was treated by hack-and-squirt. The understory treatments were implemented with glyphosate or manual cutting.

Douglas-fir, grand fir, western hemlock, and western redcedar were planted in two rows of ten trees on each treatment plot making a total of 480 trees per site. The location of the rows for each species was randomized within each treatment plot and vexar tubing was placed on every other seedling. Seedlings for each site came from local seed sources and were obtained from different suppliers so variation between sites in stock type and initial size existed.

Overstory and understory treatments were completed in the fall, 1989 and were planted in March, 1990. Seedling height, caliper, an index of browse damage, vexar tube condition, understory cover, and overstory cover were measured in May, 1990 and again in October, 1990. Analyses of the data for the first growing season were carried out to detect preliminary trends.

Results

Overstory treatment had a consistent effect on first-year height growth for both girdling and hack-and-squirt (Figure 1). Height growth for western hemlock was best where all overstory trees were killed, but there was little difference in height growth between partial and total overstory removal for the other species. Douglas-fir and grand fir grew best with a girdled overstory, while western hemlock and western redcedar grew best with the hack-and-squirt treatment. The greater height growth exhibited by Douglas-fir and grand fir due to the girdled treatment is, most likely, not a treatment effect but results from differences in seedling quality and/or size. This trend is evidenced by similar growth differences in the control plots.

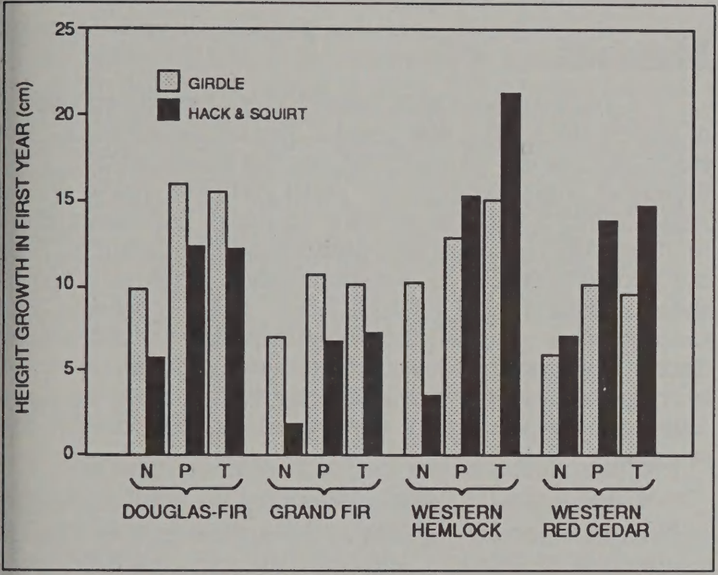


Figure 1. The effect of overstory treatment and method on the first-year height growth of four different species of seedlings underplanted in riparian forests. N, No treatment (Control); P, Partial (2/3) overstory removal; and T, Total overstory removal.

Both girdling and hack-and-squirt apparently affected height growth. This effect occurred despite differences in overstory canopy development between treatment methods. Alders girdled during the fall of 1989 leafed out fully in spring and did not have visibly less crown than adjacent ungirdled trees until late summer when they had approximately 10 percent less crown. Girdled alders also appeared to lose their leaves sooner than ungirdled alders in the fall. In contrast, alders treated by hack-and-squirt had an abbreviated leafout early in the growing season that was quickly lost. Given these differences in canopy development, a height-growth response to girdling was not expected.

Overstory treatment had an effect on survival regardless of treatment intensity or method. Western redcedar was the exception showing very good survival regardless of treatment (Figure 2). Douglas-fir and grand fir survival was greater due to hack-and-squirt which is in contrast to height growth results.

The responses of height growth and survival to shrub treatment were similar to the responses to alder treatment. Height growth was smallest where shrubs were not treated. No differences in height growth were observed between manual and spray treatments after the first growing season. Survival was higher on treated plots than on control plots except for western redcedar which had very high survival regardless of shrub treatment.

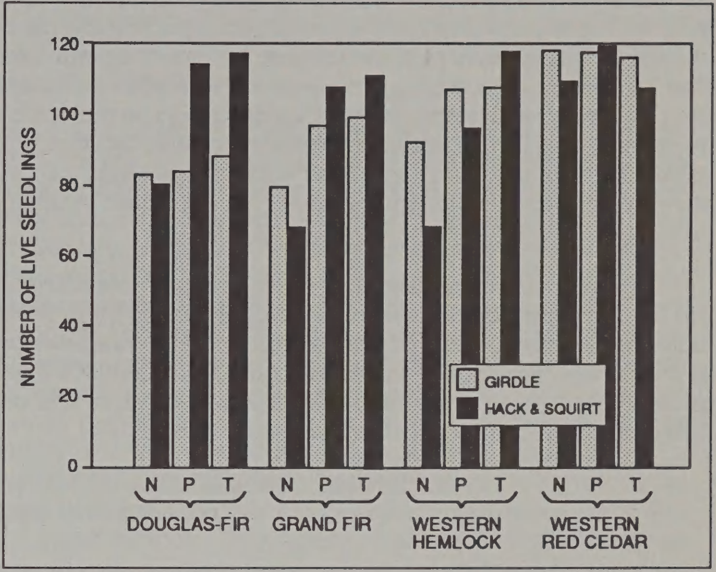


Figure 2. The effect of overstory treatment and method on first-year survival of four different species of seedlings underplanted in riparian forests. N, No treatment (Control); P, partial (2/3) overstory removal; and T, Total overstory removal.

There was no apparent treatment effect on damage by browsing but there was an effect by species. Western redcedar was browsed more than all the other species combined. Twenty percent of all western redcedar seedlings were browsed compared with 11 percent for Douglas-fir and 3.8 and 2.2 percent for western hemlock and grand fir, respectively. Western redcedar is known to be favored by elk and deer; therefore, this result was expected. Preliminary results do not support the contention that damage to western redcedar by browsing will be reduced if vegetation is left around the seedlings. The browse damage reported here is only for March to October and does not include winter browse, which can be severe.

Similarly, there was no apparent treatment effect on the amount of damage to tubes. There were differences in tube condition by species, but they appeared unrelated to external effects such as animals removing tubes preferentially from one tree species. Tube condition was evaluated as either (1) ok, (2) off (grazing animals responsible), (3) leaning (animals stepping on them or branches falling on them), and, (4) the leader growing outside the tube. For the fourth category, the seedlings are likely to experience damage and decreased growth if the leader grows out through the vexar tubes. Western hemlock and western redcedar had 44 and 34 percent, respectively, of the leaders growing out through the tubes compared with 9.6 and 6.6 percent, respectively, for Douglas-fir and grand fir. Western redcedar and western hemlock have greater problems with tubing because of their drooping leaders.

There appeared to be less height growth and lower survival when overstory vegetation was not treated. Western redcedar had very high survival regardless of treatment intensity or method; however, its growth was reduced when overtopping vegetation was untreated. Differences in height growth due to overstory treatment methods cannot be determined for any species. Western redcedar is a desirable species for underplanting because of its survivability; however, it also had the highest level of browse damage supporting the common knowledge that it is highly favored by browsing animals. The level of browse damage on western redcedar indicates that if it is planted in riparian areas it will have to be protected. Because of the high proportion of western redcedar leaders that grow through the mesh in vexar tubing, seedlings of this species will have to be maintained, as will tubed western hemlock.

We caution readers that these are only preliminary results from first-year data and that operational treatments based on these data should not be prescribed until more data is available. For further information on Adaptive COPE research on active riparian zone management or for details on this project, please contact the authors.

Steve McConnell and Gabe Tucker,
Adaptive COPE

THE INFLUENCE OF LARGE WOODY DEBRIS PIECE SIZE AND ORIENTATION ON FUNCTION IN SMALL STREAMS: FIRST-YEAR RESULTS

During the last two decades there has been an increase in our understanding of the role large woody debris plays in forest streams. Twenty years ago, woody debris was considered a source of water quality problems and often a barrier to fish migration. Thus, fisheries biologists commonly prescribed cleaning woody debris from streams following timber harvesting. Over the last two decades, research focusing on the ecological role of woody debris in streams has shown the contribution of woody debris to the structure and function of forested streams. However, simply knowing that "wood is good" is insufficient to write site specific prescriptions which include the number and size of woody debris pieces required to maintain adequate aquatic habitat.

Current federal and state guidelines reflect the importance of riparian areas as long-term sources of woody debris to streams. Consequently, a minimum number of standing merchantable conifers are prescribed for riparian zones following harvest. There is debate, on both sides of the issue, regarding the adequacy of these prescriptions. The debate focuses on whether these prescriptions optimize the supply of woody debris to streams. Critics of the current prescriptions charge that both the size and number of trees left in riparian zones are either inadequate or excessive for the purposes of supplying woody debris. Central to the debate is a lack of information regarding the recruitment rate of woody debris from riparian areas and the effect of woody debris on aquatic habitat. The lack of information is most acute for small headwater streams flowing through second-growth conifer stands. These stands, dominated by small conifers and/or hardwoods in riparian areas, are probably debris-poor because of past harvesting or stream cleaning practices.

The purpose of this study is to bring new information to the current debate by determining the effect of woody debris on aquatic habitat in small, headwater streams in coastal Oregon. To function as large channel roughness elements and create pool habitat, woody debris must be stable and remain in place for a number of years. It must also be positioned to influence stream hydraulics so that channel morphology is substantially changed. The objective of this project is to investigate the effect of large woody debris size and orientation on debris stability, stream channel morphology, and aquatic habitat in coastal headwater streams.

Methods

The treatment effect consisted of placing large pieces of woody debris into two coastal, headwater streams. The study streams are J-Line Creek, on the Salem District of the Bureau of Land Management, and Preacher Creek, on the Alsea District of the Siuslaw National Forest. Both streams are relatively high-gradient and anadromous fish-bearing. They are located in the Lobster Valley drainage of the Alsea Watershed, a designated COPE study basin. Study reaches of both streams were relatively homogeneous and lacked woody debris. The riparian areas of both streams had been harvested leaving the overstory dominated by young, even-aged red alder and the understory dominated by salmonberry and swordfern.

Specific treatments consisted of pieces of woody debris of three different sizes placed in the streams at two different orientations. The debris pieces, small, young-growth Douglas-fir logs, were limbed and bucked to approximately 20-foot lengths which is roughly twice the width of the stream channels. Debris sizes are 8-, 16-, or 24-inch diameters and orientations are either "spanners" or "ramps." A "spanner" was placed in the stream perpendicular to streamflow with the log resting on the bottom of the stream channel. This required keying the log into the streambanks. A "ramp" was oriented downstream at approximately 45 degrees to streamflow and was placed with one end in the channel and the other resting on the streambank. The debris pieces were not secured in any way. For each unique combination of piece size, orientation, and stream, three pieces of woody debris were installed, giving a sample size of 36 debris pieces.

Debris pieces were installed using a hydraulic excavator in late summer of 1989 and pretreatment measurements were made at that time. First year measurements were taken in late summer of 1990 after one winter in place. Current plans are to monitor the debris piece installations through 1998, the life of Adaptive COPE.

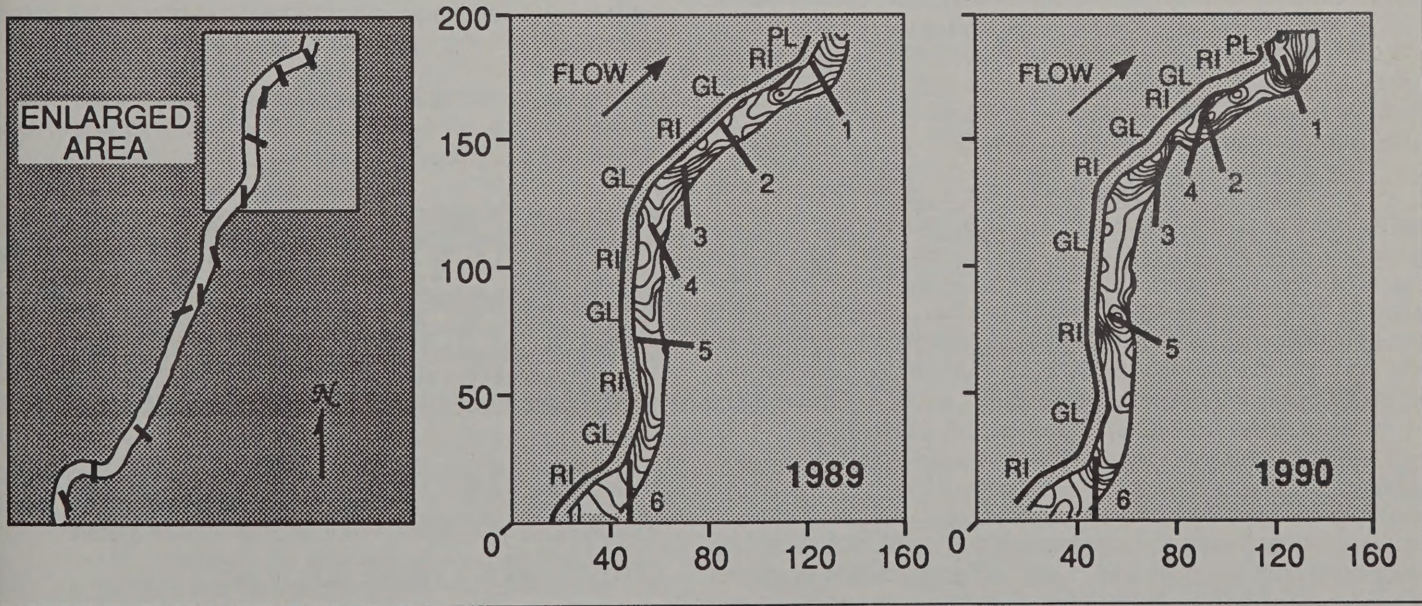
The fisheries and aquatic habitat data have been collected using conventional techniques. Stream study reaches were inventoried by identifying them as either pool, riffle, or glide habitat units and measuring the length, width, and depth of each identified unit. Width and depth measurements are dependent on the water level when the streams are inventoried. Inventories are conducted during summer low ows to minimize variation in habitat data due to differences in ater level from year-to-year. Additional inventories have een conducted during winter low flows in late March 1990 nd 1991. Fish populations were censused by electro-fishing llowing habitat inventories. Because of concerns regarding otential shocking-induced mortality of resident cutthroat trout, h population surveys will be limited to electro-fishing one me per year during late summer.

Aquatic habitat data are being reconciled with debris ece stability and channel morphology data. A stadia traerse was used to follow debris piece location and stream hannel changes from late summer 1989 to 1990. For each ream, both banks, the thalweg, any unique points of interest e., gravel bars, pools, etc.), and both ends of each piece of ebris were surveyed. From the traverse data, a topographic ap of the streambed showing the debris pieces locations was roduced using commercial software. Debris stability was vestigated by observing the horizontal and vertical moveent of the debris pieces and changes in the horizontal and ertical angles that the debris pieces make with the streambank nd streambed, respectively. Changes in channel morphology were investigated by observing changes in residual pool olume. Residual pool volume is the volume of standing water maining in the stream channel if there is no streamflow. Total sidual pool volume includes the volume of all features that ppear as depressions more than 15 cm deep on the topoaphic map made from the stadia traverse.

esults

An example of the first-year results is illustrated by a mparison of the 1989 and 1990 data for a study section in eacher Creek. Figure 1 shows the 1989 to 1990 comparison the locations of debris pieces, stream-bed topography, and aquatic habitat units for that reach. Careful observation of the figure shows that the debris pieces did move, some of them slightly and others dramatically. Plunge pools and lateral scour pools developed around the debris pieces as evidenced by an increase in the size of the residual pools. The arrangement and amount of aquatic habitat units also changed. Figure 1 illustrates the general trend of the first-year results for the debris piece project. Further data analysis is required to allow comparison of the effect of debris size and orientation on aquatic habitat, but the overall effect of addition of the woody debris can be presented.

Debris stability, as measured by movement of the debris, showed that the debris pieces tend to move into a more stable configuration. Mean horizontal movement and the mean change in horizontal angle of the debris pieces were significantly affected by two debris pieces that moved considerable distances. A 16-inch spanner in J-Line Creek moved approximately 30 feet, and an 8-inch ramp in Preacher Creek moved approximately 20 feet, making the average values for horizontal movement and change in horizontal angle difficult to interpret. Vertical movement and change in vertical angle showed opposing trends for ramps and spanners. Ramps tended to settle into a more stable position, evidenced by a decrease in the vertical distance the center of the log above the streambed and a decrease in the vertical angle the log makes with the streambed. Conversely, spanners tended to show an increase in the vertical distance of the log above the streambed and an increase in the vertical angle the log made with the streambed. The latter effect is attributed to the fact that the logs were not cabled down or constrained. During high flows the spanners could "flex" with the flow allowing small woody debris to get caught under them. As high flows receded, the logs would settle onto the woody debris resulting in an increased vertical distance above the streambed and at an increased vertical angle with the streambed.



gure 1. *Topographic maps showing location of debris pieces , stream channel topography, and aquatic habitat units in 1989 and 1990 r an experimental reach of Preacher Creek. The scale of the maps are in feet and the contour interval is 0.4 feet. RI, Riffle; GL, Glide; ., Pool.*

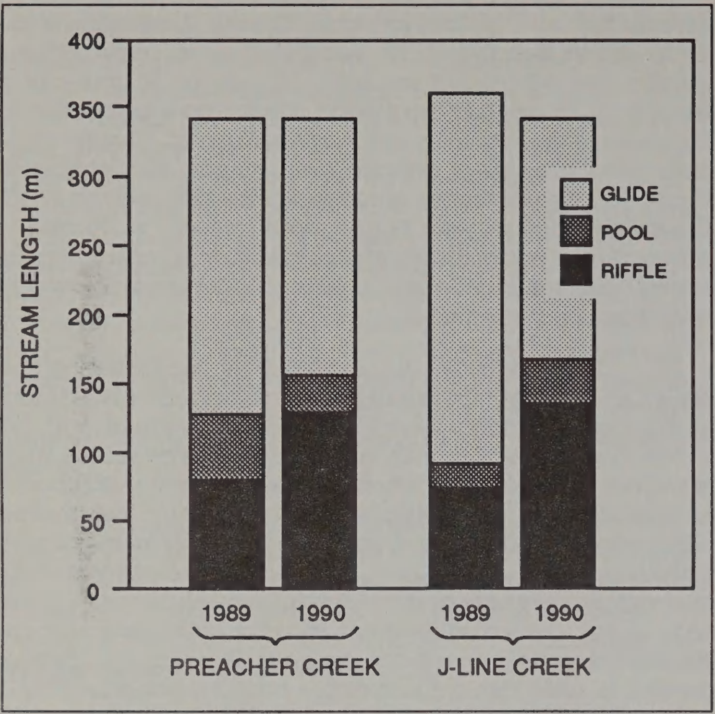


Figure 2. A comparison of the total length of pool, riffle, and glide habitat types for Preacher Creek and J-Line Creek between 1989 before large woody debris was added and 1990 after the debris had been in place for one winter.

The diversity of aquatic habitat in the two study streams increased following the addition of woody debris. In this case an increase in habitat diversity is defined as an increase in both the number and types of aquatic habitat units per unit stream length or area. In 1989, riffle habitat comprised 63 and 75 percent of the study stream length on Preacher Creek and J-Line Creek, respectively, with pool and glide habitat making up the other 37 and 48 percent of the habitat. In 1990, riffle habitat had been reduced to 55 and 52 percent of the study stream lengths for Preacher Creek and J-Line, respectively, with pool and glide habitat making up the balance of 45 and 48 percent of the habitat. This relationship is shown graphically in Figure 2. Data expressed on the basis of aquatic habitat area or volume shows the same trend as habitat expressed on the basis of stream length.

Observed effects of woody debris on stream morphology shows a similar pattern to the effect on aquatic habitat. Figure 3 shows the 1989 versus 1990 comparison for residual pool volume and area for Preacher and J-Line Creeks. The graph shows an increase in residual pool volume following debris additions to the study streams. The data indicates that the addition of large woody debris created slow water habitat (pools and glides) at the expense of fast water habitat (riffles).

Summary

These results are preliminary and to this point the data has been analyzed to show only overall effects of debris addition to debris-poor streams. However, the preliminary results do indicate that, overall, the woody debris influences stream morphology in a manner that favors slow water habitat at the expense of fast water habitat. Further analysis of current

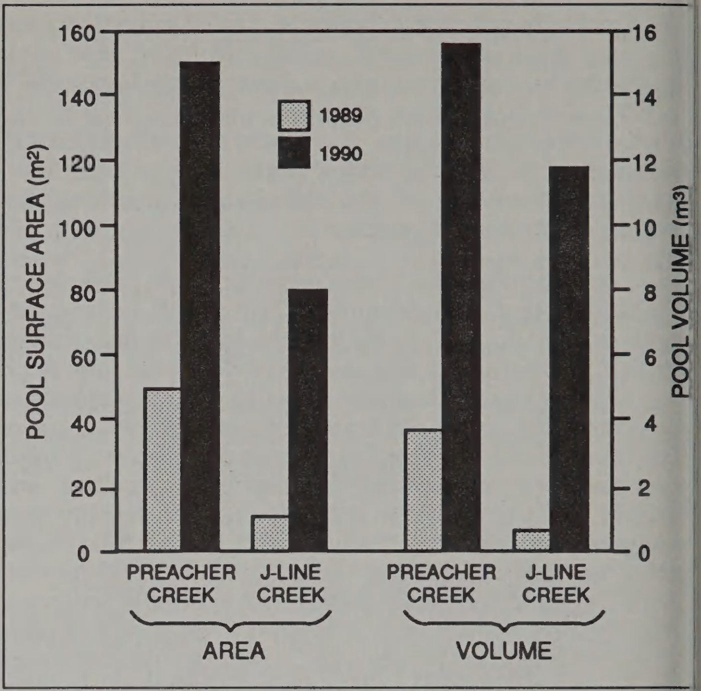


Figure 3. A comparison of the total area and volume of residu pools in Preacher Creek and J-Line Creek between 1989 and 19

data and future analysis of the debris piece installations w focus on the effect of individual piece size and orientation c stream morphology and aquatic habitat. The aquatic habit and stream morphology data will also be combined with t fish population data which should allow a consideration of fi preference for habitat in the study sections of the two stream This information should be helpful in predicting habitat ir provement when woody debris is added to streams as part stream enhancement projects and for modeling habitat ir provement due to natural recruitment of riparian trees streams. Hopefully, the results of this study will be used in t future to write site-specific prescriptions for riparian are which will maintain or improve aquatic habitat while allowir a compatible level of timber harvest along coastal streams

Arne Skaugset, Jim Schroeder, and Ron Rhe
Adaptive COI

FUNDAMENTAL COPE

FOREST HARVESTING AND COARSE WOODY DEBRIS IN THE CENTRAL OREGON COAST RANGE

Although the presence of woody debris within Pacif Northwest streams has long been recognized, perceptions of i function and value have changed through time. Over the pa two decades, research has documented an array of instream functions associated with coarse woody debris (CWD), including fish habitat formation, control of sediment routing, and effects on channel stability and morphology. However, spatial patterns of CWD loadings are highly variable and are influenced by a number of factors including logging history. This study was undertaken to evaluate the effects of forest management activities on the spatial patterns of CWD loadings as a part of a Fundamental COPE research project.

The Drift Creek Basin

Streams were chosen in the Drift Creek Basin of the central Oregon Coast Range, a COPE designated study basin. Drift Creek is a fifth-order stream centered about 16 km northeast of Waldport, Oregon which flows into the Alsea River estuary. It is about 50 km long, has an area of about 180 km², and an average annual precipitation of about 250 cm. The basin is underlain by the Tyee Formation of bedded marine sandstones and siltstones. Present overstory is dominated by Douglas-fir, western hemlock, and red alder, which is especially abundant in riparian stands. Most of the central Coast Range, including most of the Drift Creek Basin, burned extensively during 1850 to 1870, and as a result, most unharvested stands in the Drift Creek Basin are less than 150 years old. Drift Creek supports a productive fishery that includes coho salmon, chinook salmon, steelhead, and cutthroat trout.

Methods

The effects of forest management on coarse woody debris loading and debris characteristics were studied in several tributary streams in the Drift Creek watershed. There were two reasons for emphasizing subbasins:

- Small streams represent a major portion of the total stream length in a basin and hence have the potential to be widely affected by alternative harvesting options.
- CWD in small streams is less subject to fluvial import from upstream reaches or export to downstream reaches; thus debris loading is more likely to reflect management effects on the adjacent riparian forest than in the case of larger streams.

Three subbasins were selected in each of the upper, middle, and lower portions of the Drift Creek basin. Each "replicate" of three subbasins consisted of a clearcut watershed, a patch-clearcut watershed with bufferstrips, and an unharvested watershed. The names of the individual watersheds studied are identified in Table 1.

The size, species, decay class, and location in the channel were obtained for each piece of CWD greater than 0.15 m in diameter and 2 m in length that was found within or above the bankfull channel. A piece's location within the channel was described by estimating the percentage of its volume in each of four "influence zones." CWD in zones 1 and 2 has the potential to affect fish habitat and channel morphology by directly influencing high flows. CWD in zone 3 is located directly above the stream channel and is debris that will enter the channel in the future. CWD in zone 4 is located on the streambank and extends beyond zones 1, 2, or 3 and often anchors the CWD to the streambank.

Table 1. Characteristics of coarse woody debris pieces for the unharvested, bufferstrip, and clearcut treatments.

Subbasins	No. of pieces (m^3)	Median volume (m)	Median diameter (m)	Median length	Decay class [a]	Percent conifer
UNHARVESTED						
S.F. Drift Cr.	339	0.72	0.43	5.9	3.7	78
Upper Flynn	254	0.49	0.40	4.7	3.7	50
E.F. Trout Cr.	131	0.50	0.40	5.6	3.7	62
Averages	241	0.57	0.41	5.4	3.7	63
BUFFERSTRIP						
N.F. Drift Cr.	638	0.65	0.43	5.2	3.9	79
Deer Cr.	250	0.28	0.31	5.0	3.3	26
Trout Cr.	271	0.45	0.40	5.3	3.5	64
Averages	386	0.46	0.38	5.2	3.6	56
CLEARCUT						
Upper Drift Cr.	413	0.43	0.43	4.1	4.1	85
Needle Branch	173	0.32	0.37	3.2	4.2	94
Bear Cr.	76	0.62	0.48	3.8	4.3	80
Averages	221	0.46	0.43	3.7	4.2	86

[a] Log decay was subjectively classified into five categories with "1" representing relatively fresh material and "5" representing an advanced state of decay.

Results and Discussion

The areas of the lower and middle subbasins ranged from 0.5 to 6.4 km² and 2.0 to 3.7 km² for the upper subbasins. Stream gradients averaged 3.8, 1.9 and 6.1 percent for the upper-, mid-, and lower-basin tributaries, respectively. Channel substrate for the upper and lower subbasins was predominantly cobbles and boulders and for the midbasin channels it was mainly gravel-bedded. The middle subbasins had moderate side slopes with extensive valley-bottom terraces and the upper and lower subbasins had steeper side slopes and minimal valley-bottom terraces.

Conifers and hardwoods dominated the riparian overstory in the unharvested and patch cut subbasins while forbs, shrubs, and hardwoods were more abundant in the clearcut subbasins. Bufferstrips were generally greater then 30 m wide and the vegetation within the bufferstrips resembled prelogging conditions even though bufferstrips tended to have a higher proportion of deciduous overstory than the unharvested reaches. The clearcut subbasins were harvested 15 to 25 years ago when stream cleaning and/or salvage of CWD was a typical and accepted practice.

The median piece volumes and median diameters of CWD for all subbasins averaged 0.50 m^3 and 0.41 m, respectively (Table 1). Piece volumes for the stream reaches were highly variable and no significant differences existed between treatments for piece volumes or diameters. However, CWD piece lengths were significantly shorter for clearcut reaches than either the bufferstrip or undisturbed reaches. The relationship between piece length and stream width is an important indication of debris stability, and piece lengths that exceed the channel widths are considered to be relatively stable. Debris lengths greater than 6-7 m were considerably more frequent in bufferstrip and unharvested reaches then the clearcut reaches.

Coarse woody debris loading for each reach was characterized by: (1) piece frequency (the number of pieces per 100 m of stream length), (2) total volume (the total CWD volume in zones 1 through 4 per 100 m of stream length), and (3) channel loading (the debris volume in zones 1 and 2 per 100 m of stream length). CWD loading varied significantly between subbasins with the highest loading among the upper subbasins, somewhat less loading for the lower subbasins, and the least loading for middle subbasins.

Piece frequency varied from 11 to 62 pieces per 100 m of channel. CWD frequency for undisturbed reaches was greater than clearcut reaches for two of the three subbasins (Table 2). Total volume of CWD for unharvested and bufferstrip reaches was also greater than the clearcut reaches with the exception of Deer Creek (Table 2). The unharvested and bufferstrip reaches averaged 56 m^3/100 m of total CWD volume compared to 25 m^3/100 m for the harvested reaches. However, these differences in CWD loadings were not significantly different because of the high variability in loadings and the small number of replications.

Table 2. Coarse woody debris loadings for the unharvested, bufferstrip, and clearcut treatments.

Subbasins	Piece frequency (pcs/100m)	Total volume (m^3/100m)	Channel volume (m^3/100m)
UNHARVESTED			
S.F. Drift Cr.	30	107	21.4
Upper Flynn Cr.	22	27	6.5
E.F. Trout Cr.	20	33	5.0
Averages	24	56	10.9
BUFFERSTRIP			
N.F. Drift Cr.	62	105	14.7
Deer Cr.	11	7	2.1
Trout Cr.	36	56	12.3
Averages	36	56	9.7
CLEARCUT			
Upper Drift Cr.	47	39	15.2
Needle Branch	15	12	3.0
Bear Cr.	15	23	3.0
Averages	26	25	7.1

Bankfull widths of the subbasin streams averaged 4.5 m. Because of the small width, the channel loadings were low with less than one-fourth of the total CWD volume within the bankfull channel where it could directly influence channel hydraulics, stream morphology, or fish habitat. Most of the CWD was either suspended over the channel or located on the streambanks.

Characterizations of CWD decay classes indicated that CWD in clearcut reaches tended to be more decayed than CWD in the unharvested or bufferstrip reaches. Hardwoods made up 40 percent of all CWD for the unharvested and bufferstrip reaches compared to 14 percent for the clearcut reaches.

The results of this study indicate that recruitment of new CWD into clearcut stream reaches has virtually been eliminated. Since harvesting occurred, hardwood CWD appears to have been lost more rapidly than coniferous debris. Hardwoods typically decay faster than conifers and because they are smaller they are more subject to fluvial export. Also, the one or two decades since clearcut harvest has not been a sufficiently long time for trees to establish of sufficient size to provide significant amounts of either conifer or hardwood CWD. Without fresh input, CWD would consist of residual pieces in moderate to advanced states of decay, as was observed. In contrast, the unharvested and bufferstrip stream reaches continue to receive input of CWD from the riparian forest stands. This results in a more even distribution of decay classes for the CWD along the unharvested and bufferstrip stream reaches.

Differences in CWD piece lengths, decay status, species composition, and total volumes associated with the nine subbasin reaches indicate that clearcut harvesting influenced CWD characteristics in comparison to those of unharvested and bufferstrip streams. However, the high variability in CWD characteristics in conjunction with only three "replications" precluded detection of significant differences for many of the inventoried CWD characteristics. Harvest occurred only 15-20 years ago and decay and recruitment processes operate at longer time scales; thus the treatment differences may become more pronounced with time.

Conclusions

CWD measurements of nine subbasin streams in the Drift Creek Basin provide the basis for the following conclusions:

- For first to third-order streams, stand history of the riparian forests and local basin geomorphology have an important influence on CWD loadings.
- Two decades after harvesting, streams flowing through clearcut riparian zones contain debris which is shorter and more decayed than streams flowing through forested or buffered riparian zones.
- Stream reaches with bufferstrips contained CWD loads that were similar to unharvested reaches and total CWD volume for unharvested and bufferstrip reaches was over double that for clearcut reaches. However, this was not a

significant difference due to high variability and limited replications.

- The clearcut reaches had a higher proportion of coniferous CWD than the unharvested or bufferstrip reaches.
- The clearcut treatments evaluated in this study included practices prevalent in 1960's and 70's, including stream clean-up and debris salvage which do not occur today.

For more information about the topic of woody debris loading in streams or for more information concerning the details of this research project, contact the authors or see:

Veldhuisen, C.N. 1990. Coarse woody debris in streams of the Drift Creek Basin, Oregon. M.S. Thesis, Oregon State University, Corvallis. 109 p.

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SPATIAL ASPECTS OF RIPARIAN AND LANDSCAPE MANAGEMENT ON COMMERCIAL FOREST LAND IN THE COASTAL REGION

From 1987 to 1990 the COPE program supported a project to analyze "Costs of Producing Additional Nontimber Outputs from Riparian Zones in Coastal Oregon". Initially, the project took the approach that riparian zone planning techniques and theory were a subset of broader watershed, subdrainage and landscape concerns grouped under the heading of spatial planning problems. The riparian zone is but a small portion of the resource land-base, with important impacts on fisheries and water quality. These same areas provide recreational corridors for bank and boat fisherman and connecting corridors and refugia for mobile and local wildlife. Because of this, riparian zones are similar in many ways to transportation routes in that management decisions affecting these areas also have impacts throughout the total land base. Hence, riparian zone management must be viewed in the context of region-wide productivity of all resources within subdrainages and drainages.

Spatial concerns require separating land-base data into individual management units or harvest areas. Geographic information systems are valuable for providing data for individual units; however, once the map data is obtained, analytic techniques are needed for meeting objectives and constraints. Units are either harvested or not harvested in a particular time period and they are either adjacent (connected) or nonadjacent to each other. These categories relate analytically to what are described as integer variables or sometimes integer concerns.

Integer programming, a technique developed over 30 years ago, can handle integer problems; however, in application to sub-drainage problems it breaks down because it is cumbersome in both specification and solution. A small subdrainage problem for which feasible solutions were found in a matter of seconds required 65 hours on a high-speed microcomputer to find an optimal solution using integer programming. Larger problems can not be solved using this technique. The distinction between feasible solution and feasible optimal solution is the key to the first and simplest technique for finding spatial solutions.

While it is extremely difficult to find an optimal solution to a spatial problem that maximizes an objective, it is relatively easy to generate a solution that meets all constraints. This leads to a body of solution techniques known as random search. A large number of these solutions can be generated and the highest valued ones selected for further analysis and application. There is no guarantee that the best solution from a large random search sample is optimal, only high valued. In the example discussed above, the best three random search solutions were between 92 percent and 97 percent of the true optimum generated by integer programming. Random search may actually find the true optimum, but without a parallel analytic optimization process, there is no way of knowing this.

Random search techniques can provide high valued solutions to extremely large spatial problems that were unsolvable only a few years ago. Limitations of the approach are that a solution is found only for a specified problem including specification of the harvest level by period. It can not be used to study the impact of additional constraints on the harvest level as the harvest level must be given for each search. Solutions found by random search can be further processed to minimize harvest and transportation costs.

In order to allocate harvest on a watershed while meeting multiple resource constraints, a technique known as LaGrangean Relaxation was adapted to small watershed problems. The three sets of constraints dealt with were: harvest stability as represented by non-declining evenflow, nonadjacency of harvest units, and maintenance of habitat proportions for browsing animals such as deer or elk. The method is similar to optimization in that it seeks the highest valued solution subject to the constraints and minimizes infeasibilities. Integer harvesting of units and strict nondeclining evenflow clearly must be approximated rather than met with exact equality. Similarly habitat goals may only be met over time, if they do not exist at the beginning of planning.

Using this approach several watersheds were analyzed, meeting the constraints for varying periods of time. In general, nonadjacency and flow constraints could be met with little impact on harvest levels. When all three concerns — flow, wildlife habitat and nonadjacency — were combined, however, harvests were suppressed 20-35 percent. This would be of grave concern if there was a requirement for harvest flow in every decade over the rotation from each and every small watershed on a forest. However, harvest levels approaching the unconstrained sustained-yield level can be met for several decades without violating the other constraints, suggesting that periods of activity in a watershed followed by periods of no activity could remedy much of the problem.

In the final year of the project, a new approach to the spatial problem was developed based on the strongest features of optimization and random search. The approach is heuristic, meaning optimality can not be proven, but for large problems it provides better objective function values more efficiently than integer programming or the LaGrangean Relaxation approach.

The new approach was applied to several levels of riparian zone restriction on the Green River subbasin of the Alsea Ranger District, Siuslaw National Forest. In this study, prohibiting harvest in the riparian zone had an opportunity cost of $15,000 to $18,000 per foot of zone width throughout this small basin. Allowing harvest in the riparian zone with adjacency restrictions had a cost that varied from near zero to $3,500 per foot of zone width. Imposing additional lag periods (20 years instead of 10 years) for adjacent harvests, had a cost of 2.3 to 2.8 million dollars per lag period for the whole basin.

The project has developed techniques to achieve land management applications that could only be evaluated subjectively, if at all, within the recent past. Many new problems await analysis and resolution through spatial planning techniques.

Doug Brodie,
OSU Forest Resources Department

UNDERSTORY TREATMENT OF SALMONBERRY

Standard management practice on sites where salmonberry is predicted to be a problem for plantation establishment is to burn the logging slash with as hot a prescribed fire as possible to retard regrowth from basal and rhizome buds and to treat sprouts chemically or manually (or by grazing in limited cases) one or more times following planting, depending on the growth rate of the conifer regeneration and salmonberry. In some cases, it is not possible to use fire or herbicides and manual cutting becomes the only option available. The question is: when is the most effective time to manually treat salmonberry—before or after clearcutting?

The work that we have done on salmonberry clone and stand characteristics indicates that the time at which salmonberry is usually treated manually is the time during its life when it is growing most rapidly and is the most vigorous. Not only is above ground development vigorous, but rhizome growth is also at a maximum. Thus we are normally trying to achieve control at a time when it is least susceptible to the manual control treatments that are currently used.

Salmonberry development in the understory of conifer and alder stands is much slower than it is following overstory removal. Salmonberry stands present in the understory are characterized by relatively tall (up to at least 4 m), large diameter stems which may vary from one to many years old. An age is not possible to determine because annual rings are difficult to identify—but we have been following some salmonberry stands for 4 years and know that many of the stems are much older than 4 years. Cover often is 50 percent or more and stem density varies from 4 to 10 stems/m^2. These old stems continue to produce shoots annually, but their vigor generally appears low when compared to salmonberry growing in the open. New stems are initiated annually from rhizomes and the base of the old stems. These stems may grow 1 to 2 m in a year but rarely survive because of low light, severe browsing or a combination of these factors.

We initiated an exploratory study to determine the effect of manual cutting on salmonberry regrowth in the understory of alder and conifer stands. In 1987, we cut 4 m^2 (milacre) plots in conifer and alder stands and have followed the regrowth on these plots since then. Regrowth has been poor and, in some cases, salmonberry was eliminated. This small study suggested that salmonberry may be susceptible to treatment while it is still in the understory.

Based on these observations, we installed a larger study in 1989. In this study, we used plots that were about 90 m^2 (about 100 x 100 feet) in area. They were located in alder stands—two on upland sites and two in riparian areas. Within these larger areas, all the salmonberry was cut in the entire area, nine 4 m^2 plots were established. Three plots were cut once and protected from animal browsing with small exclosures, three were cut once and left unprotected, and three were cut in 2 consecutive years and not protected. Before cutting we estimated cover and measured the height and diameter of stems on each plot. Following cutting we have estimated cover and measured height each year.

Regrowth during the first year growing season after the initial cut varied between 25 and 35 percent of the preharvest height, depending on whether or not shoots were protected from browsing (Figure 1). After two growing seasons, salmonberry height on one-cut, unprotected plots, was 30 percent of original height. On protected plots salmonberry height was about 1.5 times taller than the unprotected salmonberry. In the plots cut in two consecutive years, regrowth after the second cut was 10 percent of the original height and 25 percent of the regrowth which occurred after the first cut. Percent cover recovered more rapidly than height on the one-cut plots but on the two-cut plots cover was substantially reduced. This response was almost identical among the four sites.

In clearcuts, salmonberry which is manually cut at the same time of year (March) as these understory treatments will attain precut heights after one growing season. After two growing seasons, the height of the cut salmonberry may exceed its pretreatment height and percent cover returns to pre-cut levels (Figure 1)

Cutting salmonberry in the understory obviously has a significant effect on its physical characteristics. Cutting in consecutive growing seasons seems to have an even greater effect on its ability to recover. These results suggest some alternative strategies for managing salmonberry on Coast Range sites where the use of chemicals and burning are limited or not possible. For example, there is a concern about establishing conifers in riparian areas where salmonberry is common. If it is believed that multiple manual treatments will be necessary, it may be beneficial to cut in consecutive years and not delay cuts until the salmonberry has recovered to a height where it is as tall or taller than the conifer seedlings. Another possibility may be to reduce the vigor of the post-harvest response of salmonberry by one or more preharvest cuts. We would not propose that this be done to entire units but only to those areas where salmonberry was most dense and believed to present a serious potential problem. This latter management alternative needs to be examined to see if there is a carryover effect of the preharvest treatment to the response of salmonberry after cutting.

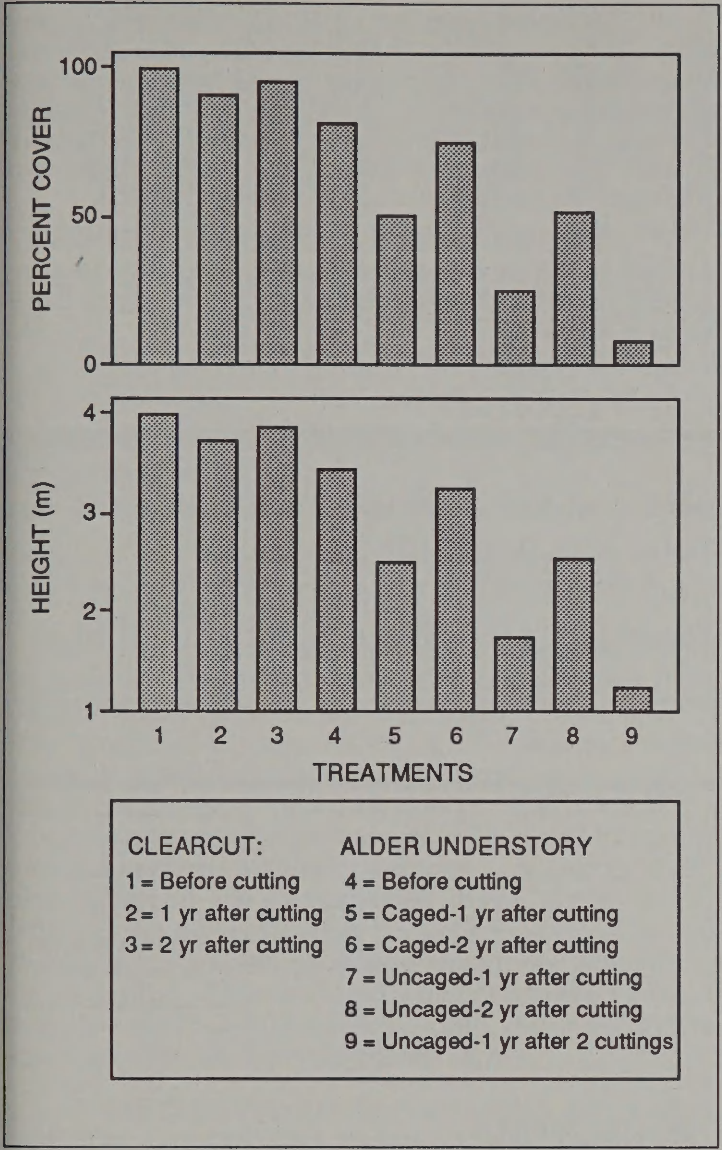

Figure 1. The response of percent cover and height growth of salmonberry to manual treatments in clearcuts and in alder understories.

These management techniques have some potentially important wildlife management implications. All of the sites sustained some level of browsing and some were heavily browsed. The old mature salmonberry understory appears to be browsed very little—the main browsing that we have seen in these stands is of the new succulent shoots that are produced annually from basal and rhizome buds. These new shoots are within easy reach of animals, while the shoots produced in the mature salmonberry canopy are not. Cutting the mature stands greatly increases the number of succulent stems available and these stems remain within reach for at least several years. (Note: When discussing these methods with folks that know the history of settlement and agriculture in the Coast Range, they indicate that grazing of sheep and goats in forested areas was an effective means of controlling the understory. Thus what we have observed on our plots mimics what was done routinely in the past but perhaps for other reasons).

We suggest that cutting salmonberry in the understory might have several positive effects. It initially creates more available browse than occurs in mature salmonberry stands. The animals plus the cutting may work to reduce the development of salmonberry after harvest, thus reducing or eliminating treatment during the time when salmonberry is most vigorous.

We believe that these results warrant further testing and are looking for sites that might be used for a more detailed study. These sites should have healthy salmonberry stands and be scheduled for harvest in 3-5 years. This would allow for several years of consecutive treatments prior to harvest to determine the most effective cutting schedule prior to harvesting and the relation of browsing to salmonberry regrowth.

John Zasada, PNW
John Tappeiner, OSU

OPPORTUNITIES

APPROACHES FOR MANAGING BIODIVERSITY: A COASTAL NORTHWEST PERSPECTIVE

July 10-11, 1991 Corvallis, OR

Emphasis on biological diversity as a natural resource has steadily increased over the years. Presently, most land managers include either maintenance of biodiversity as a central objective or use strategies to mitigate the effects of other resource development on biodiversity. Approaches for defining, understanding, and managing biodiversity, however, are not fully developed nor tested. This workshop is designed to present and evaluate current and next-generation approaches for managing biological diversity in the coastal Northwest. Specific objectives are to:

- Examine the scientific and legal rationale for managing biodiversity;
- Review approaches for managing biodiversity now employed by diverse governmental, industrial, and environmental groups;
- Evaluate "next-generation" approaches currently under development in the region.

This thorough exposure to diverse strategies for managing biodiversity should give workshop participants a context for evaluating and updating their own management schemes. For information, contact Marcy Berg, Adaptive COPE, Hatfield Marine Science Center, Newport, OR 97365 or phone (503) 867-0220.

THE DESIGN AND MAINTENANCE OF FOREST ROAD DRAINAGE

November 18-20, 1991 Corvallis, OR

A shortcourse will be sponsored by the Forest Engineering Department, Adaptive COPE, the Oregon Department of Forestry, and Forestry Extension on the design and maintenance of forest road drainage. The shortcorse will be offered in two sessions.

The first session will last two days, November 18-19, and will be a general session covering the fundamentals of forest hydrology, design and maintenance of road surface drainage, and the design and maintenance of live stream crossings. This session will present technical and quantitative concepts that will allow for the planning and consideration of alternative forest road drainage prescriptions. The intended audience for the first session is foresters, engineers, hydrologists, and other technical specialists who are involved in the planning, layout, and construction of forest roads and the planning and administration of forest road maintenance. Enrollment will be limited to 150 for the first session.

The second session will take place on the last day of the shortcorse, November, 20. This session will be an in-depth and rigorous treatment of the concepts and methods for determining pipe sizes and/or end area openings for live stream crossings. This session will be quantitative and technically rigorous. The audience is the same as for the first session. Enrollment will be limited to 50 for the second session.

If you are interested in this shortcourse please plan for it now. For more information regarding course format or content, please call Arne Skaugset at the Adaptive COPE offices in Newport.

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COPE Report

Coastal Oregon Productivity Enhancement Program

Promoting Integrated Management of Oregon's Coast Range Forests
Through Research and Education

Volume 4, Number 3

Summer 1991

The COPE Program

The Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between Oregon State University's (OSU) College of Forestry, the USDA Forest Service Pacific Northwest Research Station (PNW), the USDI Bureau of Land Management (BLM), other federal and state agencies, forest industry, county governments, and the Oregon Small Woodland Association. The intent of the program is to provide resource managers and the public with information relative to the issues and opportunities associated with the management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. The COPE Program emphasizes an integrated approach—an integration of research and education and an integration of scientific disciplines—to find effective ways to manage these diverse resources collectively.

The COPE Program has two related components: Fundamental COPE and Adaptive COPE. Comprised of OSU and PNW scientists based primarily in Corvallis, Fundamental COPE addresses problems related to riparian zone management and reforestation in the Coast Range through basic research. Adaptive COPE is comprised of an interdisciplinary team responsible for applying and adapting new and existing research information to solve specific management problems. Stationed on the coast in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for providing continuing education opportunities to facilitate technology transfer.

Published quarterly, the COPE Report provides a means to rapidly disseminate research findings, announce upcoming educational opportunities, and highlight recent publications and topics of interest. Its goal is to foster good resource management by helping people involved in the management of Oregon Coast Range resources to stay well-informed. Comments and suggestions concerning the content of the COPE Report are welcomed and encouraged. To receive this free newsletter, contact COPE, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365. Phone: (503) 867-0220.

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- 8 Summary of Precipitation for the First Half of the 1991 Water Year

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ADAPTIVE COPE
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Typing: Lori Steele

Because of space limitations, articles appear as extended abstracts. Results and conclusions may be based on preliminary data and/or analysis. Readers interested in learning more about a study should contact the principal investigator or wait for formal publication of more complete results. For specifics on the overall COPE Program, contact Steve Hobbs, COPE Program Manager, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331, (503) 750-7426; or Gabriel Tucker, Adaptive COPE Coordinator, 2030 S. Marine Science Dr., Newport, OR 97365, (503) 867-0220.

Errata: In the last issue of the COPE Report, Vol., 4 No. 2, there was an error in Figure 2 of the article "The Influence of Large Woody Debris Piece Size and Orientation on Function in Small Streams: First-Year Results." This figure is on page 6 of the newsletter. The stippling labeled "glide" in the figure should be labeled "riffle," and the stippling labeled "riffle" should be "glide."

ADAPTIVE COPE

SOUTHWEST OREGON FIELD TOUR HELD IN GOLD BEACH

The Southwest Oregon Field Tour on Forestry/Landslides/Fisheries was held June 10-12, 1991 in Gold Beach, Oregon. Approximately 80 people, including Adaptive COPE staff and speakers, attended the field tour. Participants were primarily field level resource managers from the Forest Service, Bureau of Land Management, and the Oregon State Department of Forestry. Representatives from the timber industry, California Department of Forestry, and the Quinault Indian Nation also attended. After what had been a rather dismal and wet spring on the Oregon coast, the weather broke and field tour participants enjoyed 3 sunny days on the southwest Oregon coast.

The field tour kicked off Monday evening, June 10, with a dinner and presentations on the geology and fisheries of southwest Oregon by Joe Cornell and Don King of the Siskiyou National Forest. The actual field tour started on Tuesday, June 11, with a presentation by Cindy Ricks of the Siskiyou National Forest on the geomorphology, landslides, and geomorphic hazards of the local geology. Throughout Tuesday, the field tour visited sites representative of several rock types of southwest Oregon and at each stop the geology, soils, landforms, and type of landslide hazard were discussed as well as management influences. The tour guides and discussion leaders for the day included Richard Van Dyke, Cindy Ricks, Ed Gross, and Donna Mickley of Siskiyou National Forest and Chris Jasper of the Soil Conservation Service. Wednesday started off with a stop at a tributary of the lower Rogue River and a discussion of fish habitat needs and fisheries enhancement. This discussion was led by David Harris a STEP biologist with the Oregon Department of Fish and Wildlife. The final stop was at a large 800 acre earthflow, adjacent to the Rogue River, with a number of classic landslide features. The field tour ended at midday on Wednesday.

By all counts, the field tour was a success. The speakers were consistently good, the discussions were lively, the food was good, and the weather was great. The evaluations are being reviewed to see if this field tour format can be transferred to other geologic regions of the Coast Range. Our sincere thanks to those of you who attended the field tour and made it a success.

AES

MANAGING FOREST DIVERSITY: A COASTAL NORTHWEST PERSPECTIVE

The conservation of biological diversity has become a major issue on public and private lands in the United States. Various federal and state laws require that native plant and animal species be maintained on public lands. Even private land owners are being increasingly required to mitigate the impacts of resource development on species diversity. These laws are founded on the premise that native species have value. They may be useful for producing foods or medicines, play crucial roles in ecosystem functioning, or have high aesthetic value. Less tangible elements of biological diversity such as gene pools, ecosystems, and landscapes have not yet been fully integrated into legislation. Nonetheless, conservation of these elements is included among the management objectives on many public lands.

Interest in maintaining biodiversity has grown more rapidly than have methods for managing it. Developing such approaches will require answers to several difficult questions. What is biological diversity? Which elements of biodiversity merit greatest attention? How can we best deal with the multitude of species in northwest forests? What tools exist for projecting the responses of species and landscapes under various management scenarios? How can we monitor biological diversity to ensure that management strategies are successful?

Approximately 200 forest managers and scientists attended the COPE workshop at Oregon State University on July 11-12, 1991 to address these and related questions. The introductory session defined biodiversity, explained why it is important, and described the legal directives for preserving it. The second session examined and evaluated approaches that federal, state, and private organizations are using today to manage biodiversity. Several "next generation" approaches for managing biodiversity were presented in the third session.

Among the important points that emerged from the presentations and discussions were:

- Biodiversity is an extremely broad concept; hence, management objectives need to be very carefully stated to provide clear direction for management prescriptions and monitoring.
- Considerably more information is needed on factors controlling patterns of biodiversity and the impacts of various management practices. Essential are both formal scientific research projects and field testing by managers of a range of prescriptions.
- Biodiversity is expressed over a range of spatial and temporal scales and consequently research and management need to consider factors at the microhabitat, stand, watershed, and regional levels.
- The scope and complexity of managing biodiversity exceed the capacity of individual institutions; thus, success will hinge on cooperation between industry, government agencies, private institutions, and academic organizations.
- An appropriate role for scientists and foresters is to develop and implement systems to manage biodiversity. Ultimately, however, it is up to society to determine public policy on the conservation of biodiversity.

Many thanks to all the speakers and participants. Copies of the workshop notebook are available from the Conference Office, College of Forestry, Oregon State University, Corvallis, OR 97331.

AH

A LARGE WOODY DEBRIS DATABASE FOR COAST RANGE STREAMS

Developing ways to manage for large woody debris (LWD) in streams is a key to maintaining high quality fish habitat. Questions often posed by forest and fishery managers are "How much debris do we need?" and "How do we know when a stream is debris poor?" Establishing criteria or target levels for desired sizes and amounts of debris is an important prerequisite for developing and evaluating debris management practices, whether they are adding debris to a stream or managing riparian areas to maintain or increase debris recruitment.

LWD in streams varies depending on management history, stream size, or riparian forest composition (see COPE Report 4(2):6-9). Although fish abundance has been shown to be directly related to LWD amount, there is no precise predictive relationship between amount of wood and numbers of fish. Managers currently evaluate fish habitat quality and prescribe debris management criteria by comparing the debris characteristics of typical unmanaged streams with those of the stream to be managed. Such comparisons can be difficult since debris data have been published for few streams.

We have been developing a LWD database for Oregon Coast Range streams. Data were collected by agency and university personnel as part of stream surveys conducted throughout the region over the past several years. We are using the database to document current levels of debris loading and to examine how debris characteristics vary with watershed and stand parameters.

Development of the Database

We contacted federal, state, private, and university resource specialists throughout the region in an effort to provide a comprehensive database. We incorporated into the database those surveys where LWD data have been collected in a systematic fashion for entire watersheds or long continuous stream reaches. We obtained LWD data for 69 Coast Range streams totaling 217 kilometers of stream and 28,485 pieces of debris. Survey lengths ranged from 200 to over 19,000 m and averaged about 3,000 m. Most streams were small first- to third-order streams less than 5 m wide. Sites typified the spectrum of land use history and forest successional stages present in the region.

Information was available from five major sources: BLM surveys of streams in the Nestucca, Alsea, Lobster, Coquille, and Umpqua basins, a NOAA-funded survey of streams in the South Slough Estuarine Reserve in Coos Bay, a PNW survey of Knowles Creek in the Siuslaw basin, a survey of Big Creek on the central Oregon coast by the OSU Forest Engineering Department, and Adaptive COPE surveys of three

Table 1. Characteristics of LWD from streams surveyed in various Coast Range basins.

		LWD pieces (No./100m)		LWD volume (m³/100m)	
Basin	No. of streams	Avg.	Range	Avg.	Range
Nestucca	6	17.4	9.6-24.3	12.8	9.6-22.2
Tualatin	2	15.0	6.0-24.0	4.7	1.3-8.1
Alsea/Drift/ Lobster Cr.	18	14.7	2.2-34.1	34.8	2.6-138.7
Big Creek	1	33.3	-	31.6	18.1-64.4
Siuslaw	1	3.3	-	-	-
South Slough	25	14.3	1.9-36.4	14.2	1.0-68.7
Coquille	9	13.4	3.1-43.1	6.4	1.3-12.4
Umpqua	7	13.9	5.8-38.7	8.3	4.2-16.7
Total	69				

streams in the Alsea/Drift Creek/Lobster basin (Table 1). We were unable to locate LWD data from extreme northern or southern portions of the Coast Range where debris inventories appear to be nonexistent or are poorly documented. Data from streams east of the crest of the Coast Range were available for only the Tualatin basin.

Survey techniques varied among the data sets and included measurement of length and diameter (mid diameter or mid and end diameters) of individual debris pieces, estimates of length and diameter of debris within habitat units, and classification of debris within size (length/width) classes. As a result, derived data was based on measurements or estimates common between data sets. Only debris pieces located predominantly within the stream channel were included in the analysis. Pieces located on stream banks or within the floodplain were omitted. For each stream, debris abundance was determined by the total number of pieces and total volume of LWD present within the survey area divided by total survey length and standardized to numbers or volume per 100 m. Debris size was characterized as the average length, diameter, and volume of debris within the surveyed area.

Debris abundance and size were compared between streams according to three categories of independent variables having the potential to influence the quantity and size of LWD. The first category was drainage basin variables, which included basin area, stream order, number of first-order tributaries, and gradient. The second category was a channel morphology variable, which was stream width. The third category was riparian vegetation variables, which included management history and whether the riparian vegetation was conifer, hardwood, or mixed. Management history was classified according to whether the riparian overstory was unlogged, mature forest; a mixture of unlogged and logged second-growth forest; or second-growth forest without buffers. Management history was derived from timber type maps, agency files, stream survey narratives, local resource managers, and personal observations. Aerial photo interpretation of riparian stand type and structure along all streams was used as a final check for riparian vegetation characteristics and management history.

Trends in LWD

LWD amounts were highly variable across the range of streams surveyed as illustrated by the summary statistics for the database shown in Table 1. The debris piece count ranged from 2.2 to 43.1 pieces per 100 m of stream length and debris volume ranged from 1.0 to 138.7 m³ per 100 m of stream length. The majority of the streams averaged approximately 14 pieces of debris per 100 m.

Because of this variability, there was no apparent relationship between debris piece count or volume and basin area, stream order, number of first-order tributaries, or gradient. There was a general decrease in numbers of debris pieces as stream width increased (Figure 1). Other researchers have noted a similar decline in debris frequency with stream size in their survey of LWD in streams bordered by old-growth forests. They attributed this decline to the increased capacity of larger streams to move debris downstream. They also observed that average length and diameter of individual debris pieces increased with stream width, but we found no similar pattern in Coast Range streams that represented a wide range of management histories.

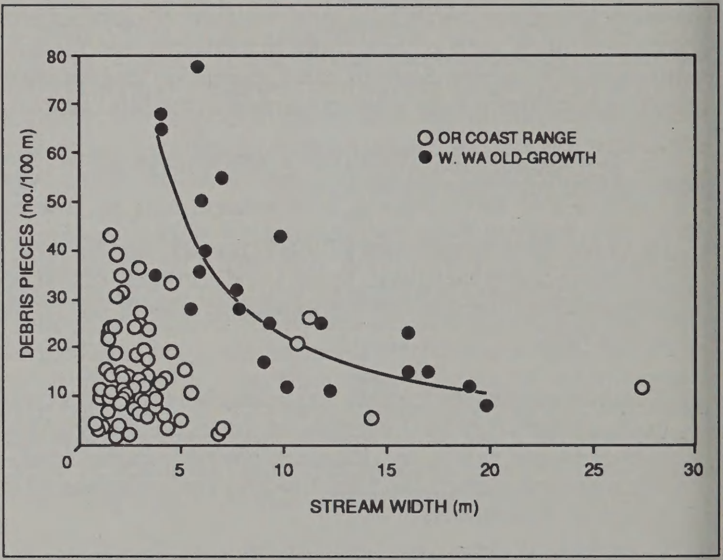

Figure 1. The relationship between number of debris pieces and stream width for Oregon Coast Range streams and for western Washington streams draining old-growth forests. The curve is drawn after Bilby and Ward (1989).

A comparison of debris piece data revealed that Coast Range streams, in general, had fewer pieces of debris than old-growth streams in western Washington (Figure 1). This difference is most likely accounted for by management history and successional stage of riparian vegetation of the streams. For example, streams running through unharvested stands, in our database, had a higher piece count than and averaged more than twice the volume of streams running through second-growth or mixed harvested and unharvested stands (Figure 2). Streams draining conifer and mixed conifer/hardwood riparian stands had similar numbers of debris pieces, but they had approximately twice the volume of debris as the streams draining hardwood riparian stands characteristic of second-growth forests which resulted from harvest without conifer retention requirements in riparian zones (Figure 2). Beschta and Veldhuisen (see COPE Report 4(2):6-9) found similar trends in their comparison of clearcut stream reaches with bufferstrips and unharvested reaches in Drift Creek. They also found that debris in clearcut sites was shorter and more decayed than in buffered or unharvested reaches.

Streams that drain second-growth stands can vary considerably in debris amounts. For example, the number of debris pieces in Big Creek was three times that of Knowles Creek in the Siuslaw basin. Big Creek had significant debris inputs from past fires and logging, and "old" debris from the previous stand contributed over 80 percent of the total debris volume in the stream. In contrast, much of Knowles Creek has been sluiced out in the past, leaving debris in only a few clumps at tributary junctions.

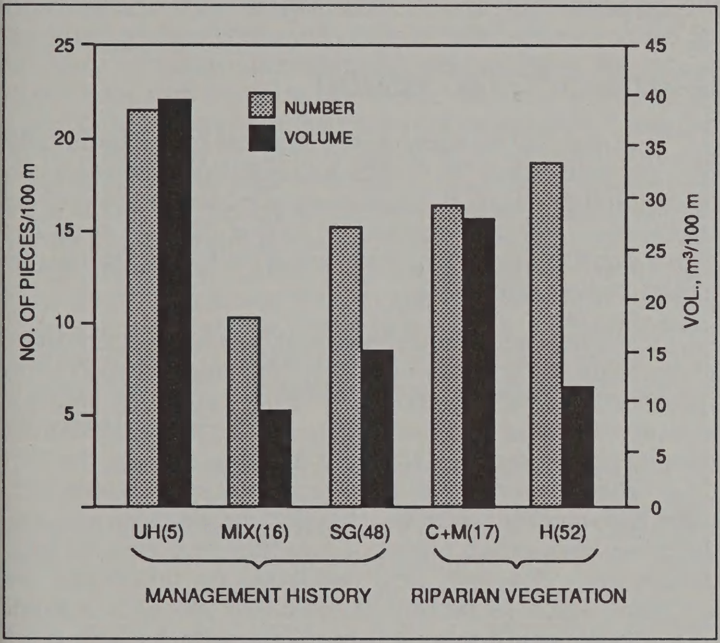

Figure 2. Numbers (per 100 m) and volume (m³ per 100 m) of LWD in streams with varying management history and riparian vegetation characteristics. Number of streams in each category shown in parenthesis. UH, unharvested; MIX, mix of harvested and unharvested; SG, second growth; C+M, conifer and mixed conifer/hardwood; H, hardwood riparian vegetation.

Limitations and Value of the Database

One of the limitations of gathering information from diverse sources is the different data collection methods. For example, minimum LWD sizes defined for the various surveys ranged from 5-20 cm in diameter and 1-2.4 m in length. Surveys also differed in how debris dimensions were determined. Our experience with compiling this database reinforces the need to develop standardized survey methods for measuring debris. Debris surveys differ not only in how debris is defined and measured, but also in how debris volume is determined (e.g., volume of a cylinder vs. volume of a cone). Some debris studies have also calculated the mass of debris per unit stream length as a standard for comparison. While surveys obviously have different objectives which influence selection of methods, we concur with the following criteria for debris measurements suggested by Veldhuisen in his Master's thesis, which is listed in the Recommended Readings:

1. LWD should be defined with common minimum dimensions. Most studies to date have used 10 cm for minimum diameter and 1 m for minimum length.
2. A common system is needed to describe the position of debris in relation to the stream channel, stream bank, and floodplain.

Future debris surveys should depend on actual measurements of LWD pieces rather than visual estimates. Actual measurements allow for easier and more accurate comparison between surveys and statistical analysis of the data. Visual estimates alone are probably not sufficiently sensitive to detect changes in LWD if they are used as a tool to monitor the effectiveness of forest plans or other land use activity. If large basins need to be surveyed and time is limited, visual estimates calibrated often with actual measurements may provide a feasible and accurate alternative. See Andrus et al. (1988) and Veldhuisen (1990) in the Recommended Readings for examples of such techniques. Such measurements will also allow placement of the data into a regional data bank, such as the Forest Science Data Bank at OSU, that can facilitate access to the data by other potential users.

With these limitations in mind, a LWD database is valuable for documenting and illustrating trends in LWD abundance over a wide geographic area. Data from Figure 2 supports previous assertions that many streams in the Coast Range are debris poor. The database also provides baseline information useful for developing debris management guidelines on a regional as well as site-specific basis. Finally, debris surveys of these same streams in future decades can provide a check on the effectiveness of our current management practices.

Recommended Readings

Andrus, C.W., B.A. Long, and H.A. Froehlich. 1988. Woody debris and its contribution to pool formation in a coastal stream 50 years after logging. Can. J. Fish. Aquat. Sci. 45:2080-2086.

Bilby, R.E., and J.W. Ward. 1989. Changes in characteristics and function of woody debris with increasing stream size of streams in western Washington. Trans. Am. Fish. Soc. 118:368-378.

Bilby, R.E., and J.W. Ward. 1991. Large woody debris characteristics and function in streams draining old-growth, clearcut, and second-growth forests in southwestern Washington. Can. J. Fish. Aquat. Sci. (in press).

Veldhuisen, C.N. 1990. Coarse woody debris in streams of the Drift Creek Basin, Oregon. M.S. Thesis, Oregon State University, Corvallis. 109 p.

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FUNDAMENTAL COPE

A BASIN PERSPECTIVE OF COARSE WOODY DEBRIS

Introduction

Coarse woody debris (CWD) is associated with many functions in forested streams including aquatic habitat formation, sediment routing, channel stability and morphology, and a food source. The pattern of CWD throughout a watershed is influenced by stream size, flow history, valley form, channel gradient, and the nature of the riparian forests along with other factors. "Natural" amounts and patterns of CWD are difficult to describe, because they vary dramatically between stream reaches and little research has been carried out to determine CWD patterns for streams of different sizes. Furthermore, not much is known regarding how CWD loading responds to watershed scale processes such as floods, fire, blowdown, and stand development. The objective of this study was to determine CWD loading and characteristics throughout a central Oregon coastal basin.

The Drift Creek Basin

CWD was surveyed throughout the 180 km² Drift Creek watershed which is centered about 16 km northeast of Waldport, Oregon. Drift Creek is representative of the central Oregon Coast Range with an annual precipitation of 250 cm, a bedrock geology of bedded marine sandstones and siltstones, and shallow, landslide-prone soils. Gradients of the main channel low in the watershed are less than one percent while for headwater channels high in the watershed they range from one to ten percent. The transition from the low gradient reaches low in the watershed to the steep reaches high in the watershed alternates between gentle and steep reaches producing a "stair step" pattern of channel gradients. Drift Creek supports a fishery which includes coho and chinook salmon, and steelhead and cutthroat trout. The forests are predominantly Douglas-fir, western hemlock, and red alder with the red alder dominating riparian stands. Between 1850 and 1870, most of Drift Creek burned during wildfires; thus, most unlogged stands remaining are less than 150 years old.

Because there has been a variety of ownerships, the basin has a complex management history. The Forest Service is the majority landowner of Drift Creek, with small portions owned by the Bureau of Land Management and the State of Oregon. The state and federal ownership combined is approximately 60 percent of the basin which has undergone dispersed clearcut logging except for the Drift Creek Wilderness along the lower mainstem of Drift Creek and the Flynn Creek Research Natural Area. Approximately 35 percent of the watershed is privately owned and has been managed intensely since around 1960.

Basin Measurements

The size, species, decay class, and location in the channel of coarse woody debris larger than 0.15 m in diameter and longer than 2 m were determined for each debris piece within the bankfull channel along the mainstem of Drift Creek and several major tributaries. The location within the channel of the debris piece was described by estimating the percentage of its volume in each of four "influence zones." CWD in Zones 1 and 2 directly affect flow patterns and sediment routing during high flows. CWD in Zone 3 is located directly above the bankfull channel and is debris that eventually will enter the channel. CWD in Zone 4 is the portion of the debris piece that extends beyond Zones 1, 2, or 3, and may anchor the piece along the bank. The CWD survey began approximately 8 km (river mile 5) above the confluence of Drift Creek with the Alsea River. The survey results were summarized for each of 12 relatively distinct reaches along the mainstem and several major tributaries of Drift Creek.

Results and Discussion

Overstory riparian vegetation was comprised mostly of hardwoods along the third order and larger channels and of forbs and shrubs on channel terraces influenced by grazing or beaver. Mature conifers dominated riparian overstory vegetation in unlogged riparian zones and where sideslopes ended at the streambank.

CWD pieces along the lower reaches of Drift Creek had median piece volumes of 1.5 m³ and diameters of 0.58 m. These volumes were considerably larger than piece volumes in most of the other reaches, which may be due to input from riparian conifer stands on streams that flow through the Drift Creek Wilderness or the selective export of small pieces from these high-gradient reaches. Median debris piece volume, diameter, and length were not significantly correlated with stream size. However, long debris pieces, defined as the length at which 84 percent of the debris pieces in a reach were shorter, were significantly correlated with drainage area. For large channels, such as the lower portions of Drift Creek, the CWD pieces rarely span the channel but piece length still, apparently, contributes to the capacity of boulders, bends, or side channels to trap CWD. An analysis of "large" CWD pieces, defined as greater than 10 m in length and 0.5 m in diameter, showed that 85 percent of the debris jams in Drift Creek contained one or more "large" CWD pieces and that reaches with a lot of "large" CWD pieces contained more jams. Many of the debris jams were anchored by large boulders or occurred at gradient changes such as falls, cascades, or rapids and these large debris accumulations apparently seldom move. In general, CWD was more decayed and pieces were more commonly grouped into debris accumulations along the mainstem than in the tributary reaches. Debris jams composed of five or more debris pieces contained one-third to one-half of all the CWD in most reaches of the mainstem.

The percent CWD volume within the bankfull channel decreased with increasing channel gradient, regardless of the amount of total loading or stream size. These results indicate a systematic trend in CWD loading because Drift Creek and its larger tributaries flow through a variety of vegetation types and valley forms. Some of the differences in

CWD loadings between stream reaches in Drift Creek may be responses to forest management. The stream reaches in the wilderness contain greater CWD loadings than other fifth-order stream reaches and the pieces are larger than in the other reaches except where debris was added for fisheries enhancement. The high loadings of "large" CWD associated with stream reaches in the wilderness may be partially attributed to the geomorphic setting. Large boulders are more frequent in the wilderness reaches than in other stream reaches in Drift Creek. Boulder deposits and large CWD are brought into the channel by landslides, which are likely to introduce large CWD, since large stream-adjacent conifers are relatively abundant along these reaches. Thus, riparian stand characteristics and geomorphic processes interact to contribute to high debris loading.

The volume of CWD loading was approximately twice as high in constrained stream reaches as opposed to unconstrained reaches. Constrained stream reaches have a large percentage of streambanks in close proximity to the toe of hillslopes while unconstrained reaches have terraces or floodplains that separate the stream from the valley walls. Constrained stream reaches may contain more CWD because of differences in riparian vegetation or different delivery mechanisms. For example, along Drift Creek, conifers are more abundant along constrained channels while alder and shrubs dominate streamside terraces. This may be attributed to site preferences for these species or indicate that terraces have been more accessible to logging, grazing, and clearing. The proximity of valley walls has less affect on CWD loading in large streams as evidenced by smaller differences in CWD loading between constrained and unconstrained reaches among larger channels.

CWD loading for Drift Creek was compared with other coastal and Cascade Range streams in the Pacific Northwest. Figure 1 shows the comparison of debris data in Drift Creek with debris data from streams flowing through (1) a coastal redwood stand in northern California, (2) a Douglas-fir stand in the Oregon Cascades, (3) a Sitka spruce/hemlock stand in southeast Alaska, (4) an alder/Douglas-fir stand on the Olympic Peninsula, and (5) an alder/spruce/hemlock stand in the Oregon Coast Range. The data from California, the Oregon Cascades, and southeast Alaska represent CWD loading for "pristine" watersheds while the data from the Olympic Peninsula and the Oregon Coast Range come from watersheds, like Drift Creek, that have been partly or entirely harvested. CWD loading for Drift Creek is substantially lower than the other basins in all channel width classes. The most comparable debris loading comes from the Big Creek basin in the Oregon Coast Range approximately 20 km southwest of Drift Creek which was harvested and burned about 50 years before the CWD survey was undertaken.

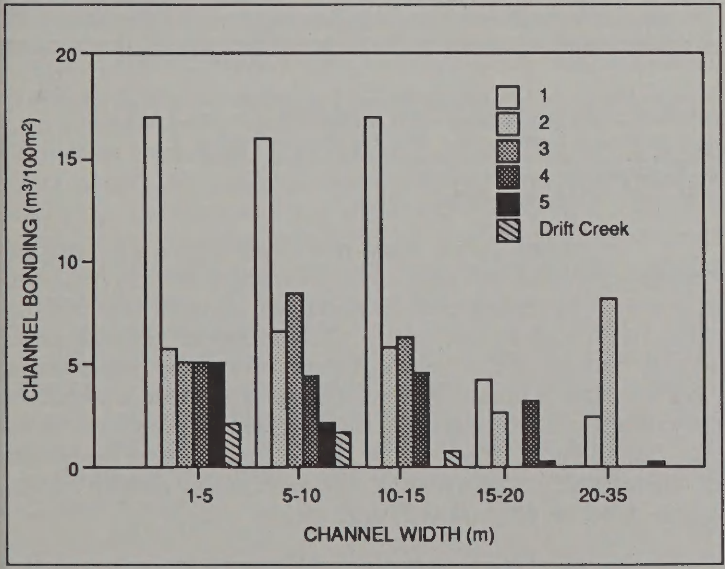

Figure 1. A comparison of coarse woody debris loading for five different channel width classes for streams in (1) northern California, (2) Oregon Cascades, (3) southeast Alaska, (4) Olympic Peninsula, and (5) Oregon Coast Range and Drift Creek.

The effects of natural forest disturbances and forest harvesting over the past 150 years may represent the major factors associated with the low CWD loadings in Drift Creek. Extensive wildfires around 1850 and 1870 burned most of the basin leaving only a few unburned areas, which resulted in little forested area with trees older than 120 years. Research indicates that 120 years after a major disturbance, most CWD will be depleted from a stream as a result of decay and high flows. Even when forest vegetation becomes established after a fire, recruitment of large conifer debris to streams is much lower during the first century after disturbance than in subsequent centuries. Although red alder may produce substantial CWD within 50 years of disturbance, the pieces are small and tend to decay rapidly.

Conclusions

CWD measurements in streams throughout the Drift Creek Basin provide the basis for the following conclusions:

1. The percentage of CWD volume within Zones 1 and 2 of the channel increases with increasing stream size. CWD in zones 1 and 2 have the greatest potential for directly affecting fish habitat, sediment transport, and local channel morphology.
2. Stream reaches that are constrained have more CWD than unconstrained reaches. However, CWD in constrained reaches is more likely to be positioned above the channel, while in unconstrained reaches it is more likely to be within the channel and on the banks.
3. Extensive fires in the mid-1800's in combination with forest harvesting in the 1960's and early 1970's throughout the Drift Creek basin have resulted in relatively low levels of CWD in Drift Creek.

For more information about the topic of woody debris loading in streams or for more information concerning the details of this research project, contact the authors or see:

Veldhuisen, C.N. 1990. Coarse woody debris in streams of the Drift Creek Basin, Oregon. M.S. Thesis, Oregon State University, Corvallis. 109 p.

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SUMMARY OF PRECIPITATION FOR THE FIRST HALF OF THE 1991 WATER YEAR

This report summarizes the data collected by the OSU Forest Engineering Department precipitation intensity network, located on the Mapleton and Alsea Ranger Districts of the Siuslaw National Forest and the adjacent lands on the Eugene District of the Bureau of Land Management. Three new raingauges have been added to the network. These gauges belong to the Forest Service and are located on the Alsea Ranger District. Data from these gauges are included in this report for the first time.

Rainfall amounts for the first half of the 1991 water year are summarized in Table 1. The average precipitation of 60.1 inches is comparable to the same time period last year which had an average rainfall of 59.36 inches. Variability between the raingauges seemed to be considerably lower than in the previous 2 water years, however.

Table 1. Monthly precipitation, October 1990 - March 1991.

	Precipitation [inches]						
Gauge	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1	12.32	18.36	7.88	14.36	12.52	14.48	79.92
2	11.16	14.32	6.48	11.48	9.32	11.00	63.76
3	11.56	13.08	5.88	9.00	8.96	11.80	60.28
4	13.36	17.00	9.24	13.80	11.76	14.08	79.24
5	9.96	12.16	5.36	8.32	7.48	10.12	53.40
6	11.76	13.12	5.28	9.28	7.40	10.88	57.72
7	10.44	11.88	6.60	6.28	7.56	10.12	52.88
8	7.40	9.40	4.92	6.12	7.12	8.92	43.88
9	8.52	9.92	5.52	7.52	6.28	9.36	47.12
11	9.68	16.00	6.88	11.24	10.28	12.32*	66.40
12	11.68	13.76	9.52	9.24	10.24	11.32*	65.76
14	8.16	11.64	6.72	6.76	9.16	11.00	53.44
15	9.84	14.96	7.40	9.48	10.44	11.08	63.20
16	8.92	12.60	6.64	7.44	8.92	9.92	54.44
Avg.	10.34	13.44	6.74	9.31	9.10	11.17	60.10

*Portion of month estimated from other gauges.

From October to November there was a series of mild storms and then a moderate storm on November 23-25 which produced 24-hour rainfall totals of between 1.88 and 4.12 inches (Table 2). These amounts compare to over 10 inches in 24 hours for the Seattle, Washington area. Rainfall decreased during December with an area average of only 6.74 inches for the month.

The biggest storm of the season occurred January 9-12. Total rainfall amounts for the storm were between 3.24 and 8.28 inches. However, rainfall intensities were 0.36 inches/hour or less. After this storm, there was a period of 13-15 days with no measurable precipitation at all. February and March had low to normal rainfall amounts with several smaller storms of low to moderate precipitation intensity (up to 0.40 in/hr).

Table 2. Precipitation amount and intensity for the two largest storms during the winter of the 1991 water year.

	Precipitation (inches)							
	11/23/90 - 11/25/90				1/9/91 - 1/12/91			
Gauge	Total	1 hr	6 hr	24 hr	Total	1 hr	6 hr	24 hr
1	5.24	0.40	1.72	4.12	8.28	0.36	1.28	4.40
2	3.56	0.36	1.72	3.08	6.28	0.32	1.20	3.00
3	2.96	0.32	1.48	2.64	5.32	0.32	1.08	2.48
4	4.28	0.44	1.68	3.60	7.96	0.32	1.36	3.68
5	2.80	0.32	1.16	2.40	5.04	0.28	1.00	2.44
6	2.88	0.36	1.28	2.60	5.12	0.28	0.92	2.40
7	-	-	-	-	3.40	0.36	0.72	1.92
8	2.24	0.24	0.92	1.96	3.56	0.20	0.72	2.20
9	2.72	0.32	1.32	2.48	4.40	0.28	0.92	2.64
11	4.80	0.44	1.80	3.88	6.60	0.32	1.28	3.56
12	2.56	0.32	1.36	2.36	5.12	0.24	0.92	2.44
14	2.56	0.20	0.88	1.88	3.24	0.20	0.84	2.04
15	3.00	0.32	1.56	2.76	4.84	0.28	0.68	2.24
16	3.44	0.32	1.52	2.96	4.00	0.24	0.92	2.52

Overall, this winter has been the mildest of the 3 years on record. While rainfall amounts have been comparable to the other years, the intensities during the major storms have been lower. This suggests that streamflows and landslide occurrences were probably lower than average over the region.

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OF INTEREST

LOGGING REQUIREMENTS TO MEET ALTERNATIVE SILVICULTURAL PRESCRIPTIONS

In recent years, there has been a move to replace traditional even-aged silviculture with alternative silvicultural systems which have been developed, at least partially, to mimic the structure and composition found in "natural" landscapes caused by such disturbances as disease, windthrow, and wild fires. Undoubtedly, changing to these alternative silvicultural systems will have both economic and social trade-offs. We currently have a poor basis for evaluating the effects of these alternative systems on economics, public acceptance, wildlife, and growth and yield.

In the College of Forestry at Oregon State University, an interdisciplinary team of researchers has undertaken a study to compare timber harvesting, regeneration, wildlife, and social trade-offs among three alternative silvicultural systems. The three silvicultural systems are clearcut, twostoried stand, and group selection. Imposed on the three silvicultural systems are either scattered or clumped arrangements of snags. The specific timber harvesting objective of the study is to compare the costs and logistics of ground skidding and cable logging among the three different silvicultural systems. This article deals only with the second-year results of the harvesting portion of the project. Harvest planning and production analysis were not undertaken for the sites installed in the first year of this study.

Study Area and Methods

The study is being conducted on the McDonald/ Dunn Research Forests, which are the research forests for the College of Forestry at Oregon State University. The research forests are located just north of Corvallis, Oregon. The stand in which the study is being conducted is predominantly 100 to 125 year old Douglas-fir, which regenerated naturally following widespread fires in the mid- to late-1800's. Stand volume is approximately 40,000 board feet per acre (MBF/acre).

The three alternative silvicultural systems are:

Clearcut
- 1.5 snags/acre created by topping or blasting
- 0.5 green trees/acre retained
- snags either scattered or grouped

Two-story stand
- 12 overstory trees/acre left
- 1.5 snags/acre created
- two-thirds of volume/acre removed compared to clearcut

Group selection
- 1/2 acre openings
- 1.5 snags/acre created
- snags either scattered or grouped
- one-third of volume/acre removed compared to clearcut
- remaining volume to be removed in two future entries.

Three replications of these alternative silvicultural systems will be established over 3 consecutive years. Harvesting costs and feasibility will be studied on two of these replications. This article deals only with the replication installed between June 1990 and February 1991. Both ground skidding and cable yarding were studied for all three silvicultural systems. Ground skidding was conducted where the terrain was predominantly less than 30 percent. For the group selection and two-story systems, designated skidtrails, spaced approximately 150 feet apart, were laid out prior to felling. Designated skidtrails were not used in the clearcut units. Uphill cable yarding was used on units where the terrain was predominantly greater that 30 percent. In the group selection and two-story stands, skyline roads, spaced approximately 200 to 250 feet apart, were laid out prior to felling. In the clearcut units, skyline roads were selected by the operator during logging.

Logging Planning and Layout

Designated skidtrails and skyline roads were laid out in the two-story and group selection stands not only for the initial entry, but also for future entries. This is especially important in the group selection stands, where only one-third of the volume was initially removed, because future openings will have to be logged without damaging the stocking in the initial openings. The planning that was developed for a three-entry group selection silvicultural system is shown in Figure 1.

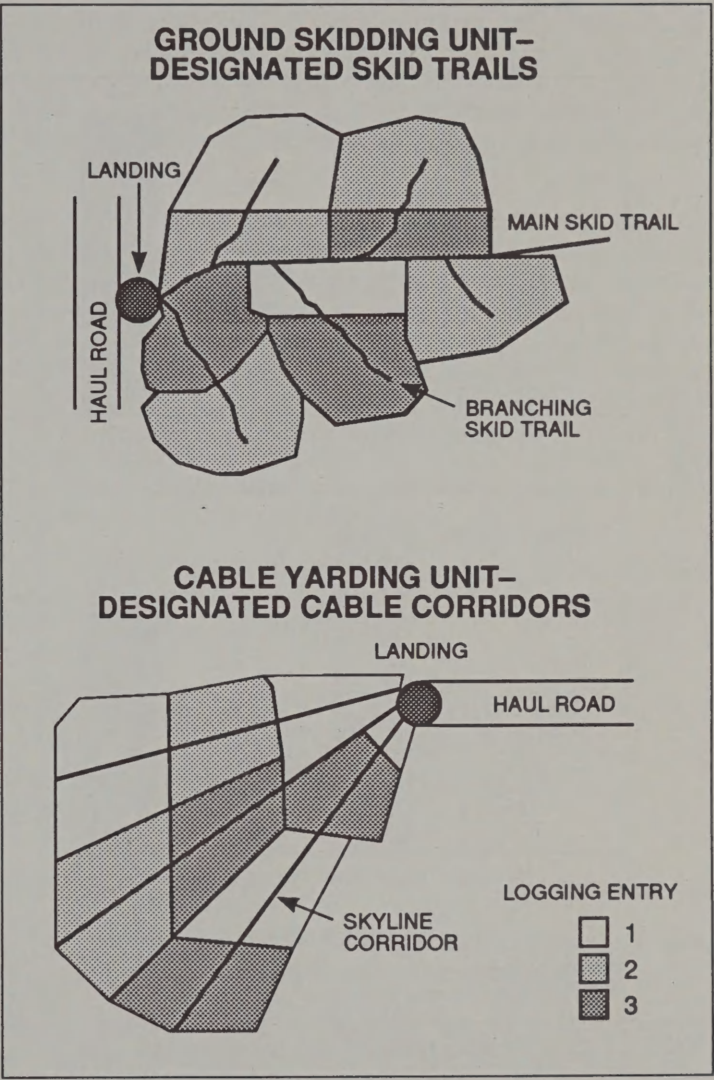

Figure 1. Group selection logging scheme for three logging entries. Only portions of the skyline spans, skidtrails, and group openings are illustrated.

The designated skidroads and skyline roads that would allow efficient logging were first located on the ground and flagged. Then the skidtrails and skyline roads were drawn on a topographic map. The 1/2 acre openings for the group selection system were identified for all three entries on this map. For the group selection cable units, as many openings as possible were concentrated along a given skyline road. This minimized the number of skyline roads used per entry. Then the design map was used to identify the initial entry openings along the flagged skidtrails and skyline roads.

Logging layout time is shown in Figure 2. Since designated skidtrails were not located in the skidder logged clearcut, estimated skidroad layout time has been included for the clearcut unit for comparison. Similarly, for the two-story cable unit, an estimated layout time for the two-story stand without skyline road designation was also estimated. For clearcut units, planning and layout included reconnaissance, flagging landings, running skyline ground profiles, marking wildlife leave trees, and map work. For the two-story and group selection units, the majority of the planning and layout consisted of flagging skidtrails or skyline roads and developing the detailed field maps.

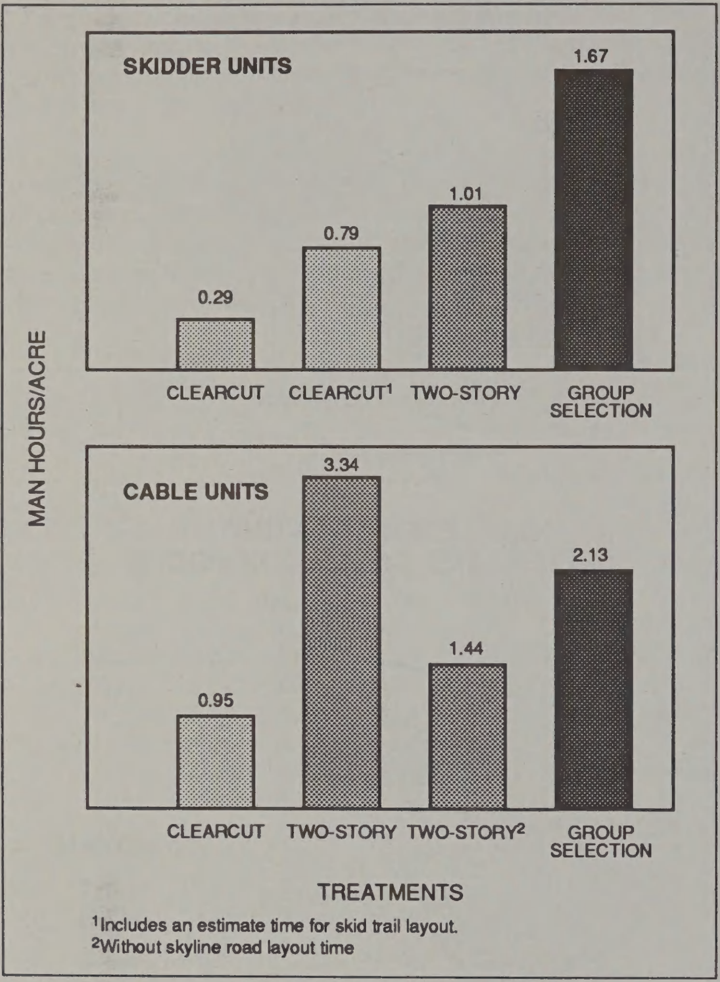

Figure 2. Logging layout times for skidder and cable units.

Logging Costs

Felling production was slightly higher and costs were lower in the group selection units than in the clearcut. All trees to be harvested in the 1/2 acre group selection openings, as well as the skid roads were marked, which made it easy for the cutters to identify the trees for felling. Since the timber stand had relatively light stocking, there was little risk of hangups, breakage of tree tops was minimized, and, typically, there were several options for each tree lay.

Felling production for the two-story stands was the lowest and the costs were the highest. Twelve trees per acre were marked and retained in this silvicultural system. For the skidder unit, the skidroads were felled and skidded first, followed by partial cut felling in-lead with the designated skidtrails. Felling the trees in-lead with the skidroads was achieved by wedging. Use of hydraulic jacks, which lowered productivity substantially, was needed occasionally near riparian areas and property lines.

For the units that were ground skidded, the skidding costs were lowest in the group selection system followed by clearcut and two-story systems, respectively. For the group selection units, removing only one-third of the volume did not adversely affect logging costs. The skidder was able to move easily into and between the 1/2 acre openings along the designated skid trails. In fact, the extra logging planning and layout contributed to improved productivity during the operational phase. The higher skidding costs for the two-story stand were due, in part, to stage logging and winch line pulling to designated skid trails. Also, there was some operational variability regarding time of year when the unit was logged and crew size, which affected productivity. In more favorable and normal conditions, the skidding costs for the two-story stand should drop slightly but still remain higher than clearcutting.

For the cable yarding, the clearcut had the highest productivity followed by the two-story and group selection systems, respectively. The yarding costs for the two-story and group selection units increased significantly, 21 and 24 percent, primarily because of the smaller volume removed. Unlike ground skidding, a substantial part of cable yarding time is spent setting up the yarder and changing cable roads. This represents nonproductive time when logs are not being yarded. Additionally, yarder crews are generally larger and the equipment more expensive than on ground skidding operations. Thus, overall yarding costs increase when a higher proportion of time is spent setting up cable roads and a lower proportion of time is spent yarding logs. Logging costs were only 3 percent higher in the group selection system versus the two-story system even though only one-third of the volume in the former was removed versus two-thirds in the latter. This can, perhaps, be partially explained by greater cable yarding efficiency when the logs are grouped in small openings rather than scattered among standing leave trees.

The total logging costs for ground skidding and cable yarding for all three silvicultural systems are summarized in Table 1. An increased level of planning and layout was clearly required for the successful implementation of the two-story and group selection systems. Even though this planning paid off during the logging operation, there were still significant up front time commitments and costs associated with low volume per acre removals. Felling costs were least affected by the alternative systems. Ground skidding costs were influenced most by the two-story system while cable yarding costs were influenced most by the group selection system. For ground skidding, the increase in total costs for the two-story and group selection systems over clearcutting were 16.4 and 2.4 percent, respectively. For the cable yarding, in contrast, the increase in total costs over clearcutting were 23.4 and 24.7 percent for the two-story and group selection systems, respectively.

Future Considerations and Conclusions

There are some further items that need to be considered with these alternative silvicultural systems, especially

Table 1. Total costs for both ground skidding and cable yarding for three alternative silvicultural systems.

	Silvicultural systems		
	Clearcut ($/MBF)	Two-story ($/MBF)	Group selection ($/MBF)
Ground skidding			
Logging layout	0.14	0.72	2.66
Felling	6.64	7.43	5.87
Skidding	25.89	29.88	24.93
Total	32.67	38.03	33.46
Cable			
Logging layout	.38	2.52	2.40
Felling	5.33	5.68	5.15
Yarding	39.92	48.13	49.33
Total	45.63	56.33	56.88

those systems that require future logging entries such as the group selection system. Wildlife trees that are created by blasting or by cutting the top out will be future logging hazards and their location relative to future felling, skidding, and yarding operations needs to be carefully considered. For cable yarding, consideration must be given for future guyline anchors and tailstump needs. In this study, as much as possible, trees were left in appropriate locations for future guyline and tailhold anchors. Tailtrees were protected during logging using special gear such as nylon straps. Even with a high level of planning, future entries may require more costly anchors such as buried logs or substitute earth anchors. Finally, there may be more efficient group selection designs for cable logging than the 1/2 acre circular openings. In the third replication of this study, small wedge-shaped and rectangular strip-shaped openings are being designed and evaluated as alternatives.

This study shows an example of the logging planning and operational requirements needed to meet "new forestry" alternative silvicultural prescriptions, reveals the need for technically trained forest engineers to be involved in the design and implementation of future alternative silvicultural systems, and also presents the increased costs associated with "new forestry" alternative silvicultural prescriptions. These increased costs are one piece of information that is needed for evaluating alternative silvicultural systems.

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Richard Edwards,
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OPPORTUNITIES

DESIGN AND MAINTENANCE OF FOREST ROAD DRAINAGE

November 18-20, 1991 **Corvallis, OR**

Brochures are now available for this shortcourse which will be held at the LaSells Stewart Center on the OSU campus in Corvallis, OR. The shortcourse is designed to present state-of-the-art information on the design and maintenance of both live stream crossing culverts and surface road drainage alternatives. It is the joint product of Adaptive COPE, the Oregon Department of Forestry, OSU Forest Engineering Department, and OSU Forestry Extension. The three-day shortcourse will consist of two parts. The first part will be a two-day overview on forest road drainage including sessions covering forest hydrology, surface road drainage alternatives, and live stream crossings. The second part will be a one-day technical session which will present sizing culverts for live stream crossings in depth. The two-day session has an attendance limit of 150 people and the one-day technical session has an attendance limit of 50 people.

The shortcourse is intended for forest engineers, hydrologists, and other technical specialists involved in the planning, layout, and construction of forest roads and the planning and administration of forest road maintenance. Participants must have a quantitative background and approach the solution of forest road drainage problems using contemporary engineering techniques. The shortcourse will include quantitative problem solving methods and, at times, be technically rigorous. Participants should come expecting such rigor and those attending the technical session on the third day should bring a calculator.

For additional information contact the Conference Assistant, College of Forestry, OSU 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

A SYMPOSIUM ON A REGIONAL ASSESSMENT OF STREAM HABITAT INVENTORY AND MONITORING PROGRAMS

May 13-14, 1992 **Corvallis, OR**

Planning and program development are underway for a symposium that will address various aspects of stream habitat inventory monitoring programs. The symposium will be sponsored by the COPE Program, American Fisheries Society, Society of American Foresters, and others. The intent is to provide an in-depth look at inventory techniques currently in use as well as review a variety of current inventory and monitoring programs. The symposium will be held at the LaSells Stewart Center on the OSU campus. Please plan now to attend. Registration and formal program announcement will begin in mid to late February, 1992.

RECENT PUBLICATIONS

EFFECTS OF SOIL CHANGES CAUSED BY RED ALDER (*Alnus rubra*) ON BIOMASS AND NUTRIENT STATUS OF DOUGLAS-FIR

(*Pseudotsuga menziesii*) SEEDLINGS by Stanislaw Brozek. 1990. Canadian Journal of Forest Research 20:1320-1325. In previous studies red alder has been shown to change soil properties, including increased soil N on nitrogen-deficient sites and increased soil organic matter. These soil property changes have had a nutritive effect resulting in increased growth of Douglas-fir, particularly on poor sites, as long as the red alder did not compete with Douglas-fir for light.

In this paper, 4-year growth and nutrient status are compared for Douglas-fir seedlings on two adjacent plots. An old-growth forest, which had been harvested 50 years ago, was partially replanted to Douglas-fir, and the rest of the stand seeded in to red alder. A plot was established in each stand type and differences in seedling growth and nutrient status were attributed to site characteristics resulting from overstory species domination (red alder vs. Douglas-fir) in the second rotation.

Seedling growth differences included: more foliage, twigs, and stems on the red alder site, no difference in root biomass, more lateral root development on the red alder site, deeper rooting on the Douglas-fir site, and slightly greater shoot/root ratio on the red alder site. Nutritional differences included: higher N and lower P, Ca, and Mg concentrations and higher N/P and N/K ratios in the seedlings on the red alder site.

These nutritional and biomass changes are similar to results found in N fertilization experiments and are attributed to N accumulation in the soil by the red alder. Disharmony in P economy and accelerated soil P depletion on the red alder site are negative effects also attributed to the red alder.

This paper contains data that decision makers can use in investment analyses for managing timberlands. Information on nutritive aspects and potential enhanced growth of future conifer stands may be valuable for evaluating management of red alder. This data may also contribute to the knowledge base for maintaining or enhancing site productivity and evaluating tradeoffs involved to manage for diversity.

SM

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